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BOOK 'OPTIMAL AND ROBUST SCHEDULING FOR NETWORKED CONTROL SYSTEMS' REVIEW

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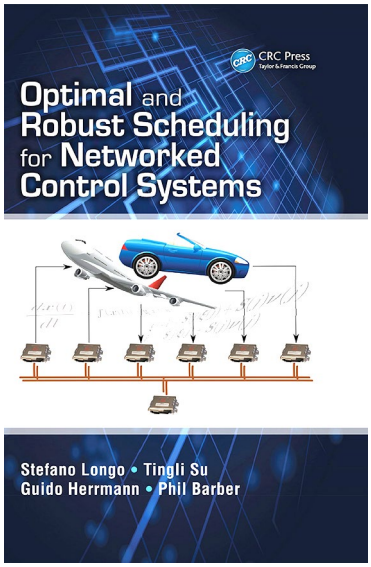

These days, networking infrastructure is a critical part of modern control systems, and therefore, understanding the control design methods is deep priority and has important consequences affecting the system stability and performance. The book under review (Longo *et al.* 2013) is a timely contribution to the area of vehicle-related Networked Control Systems (NCS), which analyzes in detail the review of current literatures, various well known limitations and weaknesses of networked systems in the controller and function design, and then uses the robust control communication theories to design the optimal and robust scheduling problem for in-vehicle network analysis.

The authors (Longo *et al.* 2013) are highly experienced researchers in the field of automatic control, as evidenced by their numerous papers published in top journals or conferences proceedings, and also excellent experts in exchanging their stories, for they illustrate the mathematically rigorous formulations in robust schedule design with proper and comprehensible examples. With their new book, as the authors have claimed in the preface, they seek to provide deep technical aspects of the unique combination of control theory, network analysis and configuration in the reliable and robust design of control system across networks. This book under review is organized into 4 parts, and each of these parts is further divided into 2~3 chapters. Notably, some chapters are prepared based on the authors' previously published materials.

The first part summarizes the recent advances in the studies of control system and linear NCS theory with the first two chapters. *Chapter 1* sets out a short motivational overview of real-time control systems, networked control systems, and limited communication systems with exact examples that are relevant for this study and then the aims and purposes of this book are introduced (p. 1–8). *Chapter 2* reviews the basic definitions, system structures and components, and control models of NCSs, and introduces three typical techniques, including control methods, scheduling methods, and scheduling and controller code sign methods, which can be used to control the NCSs, as well as their corresponding advantages and disadvantages (p. 9–46).

The second part includes the subsequent three chapters and it mainly discusses how to construct and solve the problem of NCS optimization. *Chapter 3* constructs a general unified framework for NCSs with limited communication, which extends the standard networks to analyze a large class of NCSs (i.e., multi-

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networks, subnetworks and task scheduling), and then the discussed methods are efficiently applied to practical cases of multirate systems, switched and delayed systems, and vehicle brake-by-wire control systems (p. 47–86). *Chapter 4* considers the preservation of structural properties of a class of NCSs, including the controllability and observability of NCSs with Zero-Order-Hold (ZOH) and the stabilizability and detectability of NCSs without ZOH, which helps understand and guarantee the preservation of structural properties of a system (p. 87–110). Based on the discussions and findings from previous two chapters, *Chapter 5* studies the suitable optimization methods (i.e., Genetic Algorithm, Particle Swarm Optimization algorithm) for exploring the optimal/robust offline communication sequences (p. 111–128). Then the methods, proved with better performance, are applied to the optimization of multirate NCSs and vehicle brake-by-wire control system.

The third part is dedicated to introduce the design techniques for NCS modeling with the next three chapters. *Chapter 6* provides the techniques and examples for the code sign of controller and communication sequences (p. 129–142). In this chapter, the theoretical framework discussed in Chapter 3 is used to model the NCS and a standard Linear Quadratic Regulator (LQR) problem is proposed to determine the cost function; then the design of the joint controller and schedule is transferred into a single optimization problem to be solved by the stochastic algorithms. After the description of framework modeling, *Chapter 7* deals with the methods for static communication scheduling optimization for a given plant and controller in an NCS (p. 143–154). Here, the framework is given to describe a Linear Time-Invariant (LTI) model of closed-loop NCS with schedulers, and then a quadratic Lyapunov function is constructed, whose optimal cost is solved using the proposed algorithms. *Chapter 8* dedicates to incorporate the framework, cost function, optimization algorithm and other ideas that discussed in previous chapters into the robust design of communication sequences (p. 155–176). In addition, this chapter considers three major methods to construct the cost function and the corresponding robustness. Performance and advantage of the presented methods are compared.

The final part applies the developed design techniques into the loop automotive control systems and nonlinear NCSs, in *Chapter 9* (p. 177–210) and *Chapter 10* (p. 211–230), respectively. As the overall conclusions of this book, these two chapters examine the performance using the relevant techniques presented in previous chapters, and thus close the detailed and reasoned modeling analysis from the demonstration of real applications.

Optimal and Robust Scheduling for Networked Control Systems is a unique contribution to the area of vehicle-related networked control systems for automotive industry, in which the co-design of the control and communication network scheduling is fully explained in a harmonious structure and logical manner. This book explains and illustrates the theory of concepts rigorous control design using the mathematical formulations with proper examples and explanatory figures in each chapter. The full application cases in the last two chapters also help the readers to understand the presented control design methods for NCS clearly. I fully believe, therefore, that it will attract a wide interest from both theoretical and practical readers.

Reference

Longo, S.; Su, T.; Herrmann, G.; Barber, P. 2013. *Optimal and Robust Scheduling for Networked Control Systems*. CRC Press. 280 p.