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WIDE

Decentralized Wireless Control of Large-Scale Systems

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With the help of	
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Dissemination Level

PU	Public
PP	Restricted to other programme participants (including the Commission Services)
RE	Restricted to a group specified by the consortium (including the Commission Services)
→ **CO**	Confidential, only for members of the consortium (including the Commission Services)

Executive summary

Report describing the status of the Networked Control Systems handbook.

1 Handbook

The handbook is currently in the final stages of the production phase, the galley proofs were corrected during a few iterations in September 2010. Figure 1 shows the book cover. A printed copy of the book will be available within the next two months, and will be advertised at the Springer stand during the Conference on Decision and Control, December 2010, Atlanta (GA).

A final draft of the book in PDF will be available at the review meeting. It cannot be included here due to copyright issues.

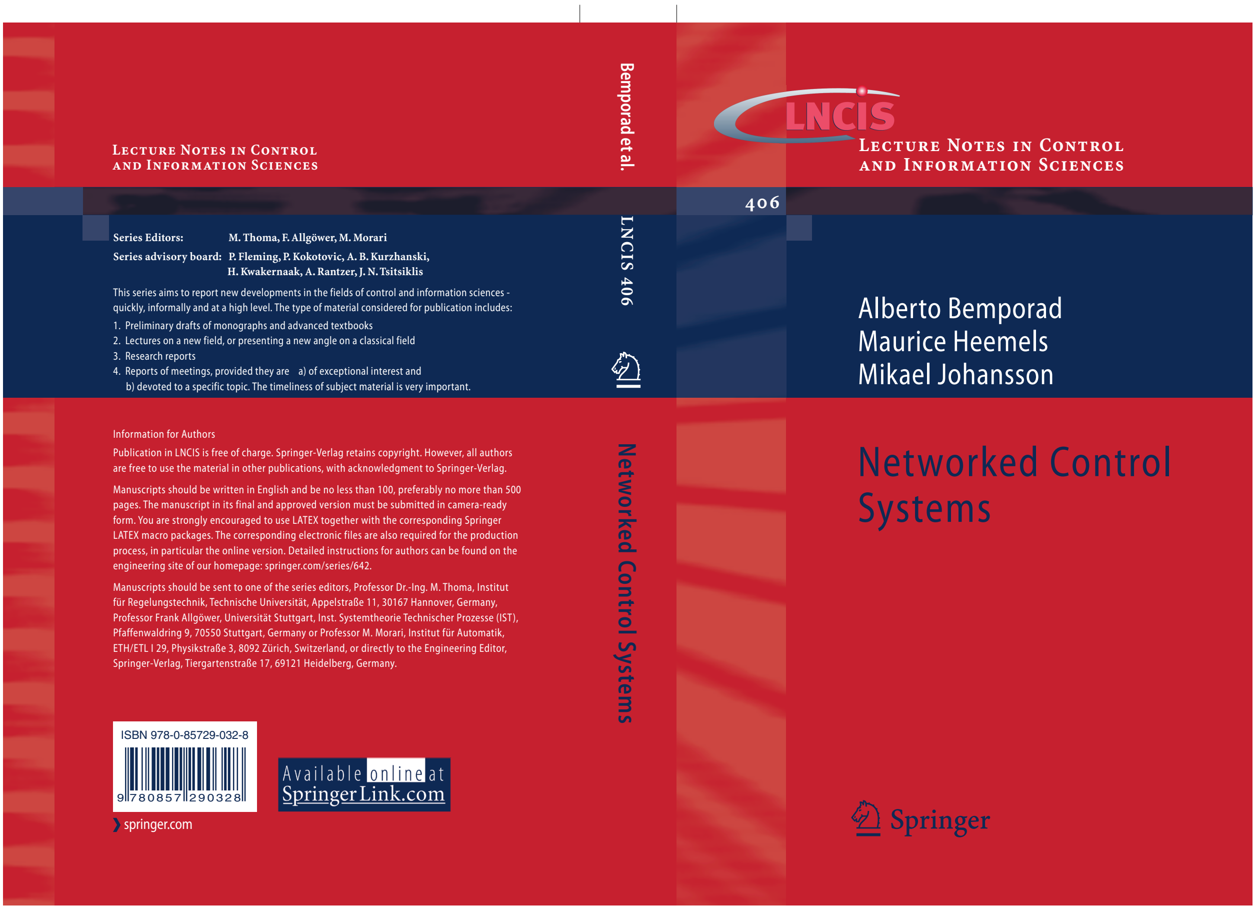

Figure 1: Cover of the Handbook on Networked Control Systems

Foreword

This book finds its origin in the WIDE PhD School on Networked Control Systems, which we organized in July 2009 in Siena, Italy. Having gathered experts on all the aspects of networked control systems, it was a small step to go from the summer school to the book, certainly given the enthusiasm of the lecturers at the school. We felt that a book collecting overviews on the important developments and open problems in the field of networked control systems could stimulate and support future research in this appealing area. Given the tremendous current interests in distributed control exploiting wired and wireless communication networks, the time seemed to be right for the book that lies now in front of you.

The goal of the book is to set out the core techniques and tools that are available for the modeling, analysis and design of networked control systems. Roughly speaking, the book consists of three parts. The first part presents architectures for distributed control systems and models of wired and wireless communication networks. In particular, in the first chapter important technological and architectural aspects on distributed control systems are discussed. The second chapter provides insight in the behavior of communication channels in terms of delays, packet loss and information constraints leading to suitable modeling paradigms for communication networks.

The second part focuses on decentralized and distributed control, estimation and optimization. The network aspect is here that not all information is available in one central controller, estimator or optimizer, but local agents have only limited information of the overall control, estimation or optimization problem and still aim at solving the central problem in an appropriate manner. Although the information might be limited for each individual agent, it is assumed that communication is ideal and imperfections such as communication delays, possible loss of information and quantization effects are ignored. Chapter 3 discusses distributed estimation and consensus problems and the fourth chapter surveys distributed optimization techniques. Chapter 5 and 6 provide overviews on decentralized and distributed control. The emphasis in chapter 5 is on decentralized and distributed model predictive control techniques.

While communication imperfections induced by the presence of a non-ideal and uncertain network channel are ignored in the second part of the book, they form the main topic of the third part. Methods for stability analysis and controller synthesis of control loops closed over communication channels are treated in chapter 7. Using appropriate models of networked control systems it is investigated how network-induced phenomena such as varying delays, varying sampling intervals, data loss and communication constraints influence the stability and performance of control loops. Chapter 8 studies the effects of the limited capacity of channels, *e.g.* limited bandwidth, on feedback control. Fundamental limitations in control using quantized information are discussed in detail in this chapter. Finally, chapter 9 treats control systems that do not use the conventional periodic sampling, but update their information based on specific discrete events. The resulting event-triggered feedback controllers have the potential to reduce the amount of communication required in networked systems while preserving the overall system's stability and performance. This last chapter provides in-depth analysis techniques for event-triggered control, estimation and optimization.

In summary, this book provides overviews on many facets of networked control systems. The writing of the book would have been impossible without the enormous efforts of the lecturers of the school and we are certainly indebted to them. We are also grateful to Davide Barcelli, who was responsible for the technical assembly of the separate contributions of the authors into one book. Finally, the support by the European Commission through the FP7-ICT-2007-2 thematic programme under project WIDE "Decentralized and wireless control of large-scale systems" (project no. 224168) for writing this book is greatly acknowledged.

We hope that you will enjoy reading this book and that it will be of assistance in your own research endeavors in the area of networked control systems.

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