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José M. Maestre · Rudy R. Negenborn
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Distributed Model Predictive Control Made Easy

 Springer

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We are driven by self-interest, it is necessary to survive. But we need wise self-interest that is generous and co-operative, taking others' interests into account.

Dalai Lama

A small boat with only one pole cannot sail across a sea; Paddling many quants together can move a huge carrack.

*A small tree standing alone cannot resist a storm;
Acres of forest can survive extremely cold winters.
One chopstick by itself can be broken easily; A dozen
of chopsticks bundled together are very strong.
One hand by itself cannot make any sound; Applause
of many hands together can be very loud.*

Freely translated lines from Chinese song "Paddling together moves a huge carrack"

Disheng Fu

Preface

In the beginning of 2012, we were discussing the value that automatic control could have for a type of system that had not been considered by the control community before, viz. large-scale intermodal transport networks, typically being considered the interconnection of road, rail, and water infrastructures. We soon got to the question about what kind of control architecture we could propose.

Information and communication technology is rapidly being introduced for this type of system, facilitating data collection and remote actuation. At the same time, domain specific scientists are working on making models that could explain the behavior of such a system using measured data. Such models can in the future be used for making predictions of dynamic behavior. Then, after defining optimal behavior from the perspective of the different actors, we could assess the performance of different predicted behaviors. It is therefore reasonable to explore the development of model-based controllers further, in particular distributed model-based controllers, as we are facing a system of a very large scale, that moreover involves many different actors. Now, the question is: What distributed model-based control structure would be the most appropriate? This is not an easy question to answer.

Over the years, a large group of research groups has focused on advancing distributed model-based control techniques. We found that a coherent overview that introduces the reader to many techniques available was missing. Hence, we brought the idea to create such an overview to the control community. This book in front of you is the result. For us, the book will directly contribute to answering the question what kind of distributed model-based control technique could be appropriate for control of large-scale intermodal transport networks, or parts thereof. Apart from this, we hope that this book will also help other researchers' to find those schemes that could be useful and provide them with insight in what has been done, and what has not been done.

This book features 35 contributions, each describing noncentralized model-based predictive control techniques. The authors of the contributions have structured their contributions along a common framework as much as possible. The intended audience of this book consists of researchers, (technically oriented) control practitioners, M.Sc. and Ph.D. candidates. The readers aimed at have backgrounds in optimization and control.

We thank all authors for their high-quality contributions and the reviewers for their constructive remarks and suggestions; without them this book would not exist. We also thank Ms. Jacobs, Ms. Feenstra, and Ms. Pot for their guidance in the publication process at Springer. Moreover, we acknowledge the financial support for this project via the VENI project “Intelligent Multi-agent Control for Flexible Coordination of Transport Hubs” (project 11210) of the Dutch Technology Foundation STW, a subdivision of The Netherlands Organisation for Scientific Research (NWO), and the projects “Model Predictive Techniques for Efficient Management of Renewable Emicro-Networks” (project DPI2010-21589-C05-01) and “Networked Model Predictive Control” (project DPI2008-05818) of the Spanish Ministry of Economy and Competitiveness. Finally, financial support from the EU Network of Excellence Highly Complex and Networked Control Systems (HYCON2) under grant agreement no. 257462 is also gratefully acknowledged.

We hope that you as reader reading this book will appreciate the aggregated efforts of the 88 authors that contributed. Let this book inspire you in your professional activities and stimulate you to explore to use of distributed model-based control techniques.

Suggestions are welcome, so please do not hesitate to contact us via: <http://distributedmpc.net/>.

Sevilla & Delft
February 2013

José M. Maestre
Rudy R. Negenborn

Contents

1	On 35 Approaches for Distributed MPC Made Easy	1
	R. R. Negenborn and J. M. Maestre	
Part I From Small-Scale to Large-Scale: The Group of Autonomous Systems Perspective		
2	Bargaining Game Based Distributed MPC	41
	F. Valencia, J. D. López, J. A. Patiño and J. J. Espinosa	
3	Cooperative Tube-Based Distributed MPC for Linear Uncertain Systems Coupled Via Constraints	57
	P. A. Trodden and A. G. Richards	
4	Price-Driven Coordination for Distributed NMPC Using a Feedback Control Law	73
	R. Martí, D. Sarabia and C. de Prada	
5	Distributed MPC for Consensus and Synchronization	89
	M. A. Müller and F. Allgöwer	
6	Distributed MPC Under Coupled Constraints Based on Dantzig-Wolfe Decomposition	101
	R. Bourdais, J. Buisson, D. Dumur, H. Guéguen and P.-D. Moroşan	
7	Distributed MPC Via Dual Decomposition and Alternative Direction Method of Multipliers	115
	F. Farokhi, I. Shames and K. H. Johansson	
8	D-SIORHC, Distributed MPC with Stability Constraints Based on a Game Approach	133
	J. M. Lemos and J. M. Igreja	

9	A Distributed-in-Time NMPC-Based Coordination Mechanism for Resource Sharing Problems.	147
	M. Y. Lamoudi, M. Alamir and P. Béguey	
10	Rate Analysis of Inexact Dual Fast Gradient Method for Distributed MPC	163
	I. Necoara	
11	Distributed MPC Via Dual Decomposition.	179
	B. Biegel, J. Stoustrup and P. Andersen	
12	Distributed Optimization for MPC of Linear Dynamic Networks	193
	E. Camponogara	
13	Adaptive Quasi-Decentralized MPC of Networked Process Systems	209
	Y. Hu and N. H. El-Farra	
14	Distributed Lyapunov-Based MPC	225
	R. Hermans, M. Lazar and A. Jokić	
15	A Distributed Reference Management Scheme in Presence of Non-Convex Constraints: An MPC Based Approach	243
	F. Tedesco, D. M. Raimondo and A. Casavola	
16	The Distributed Command Governor Approach in a Nutshell	259
	A. Casavola, E. Garone and F. Tedesco	
17	Mixed-Integer Programming Techniques in Distributed MPC Problems.	275
	I. Prodan, F. Stoican, S. Olaru, C. Stoica and S.-I. Niculescu	
18	Distributed MPC of Interconnected Nonlinear Systems by Dynamic Dual Decomposition.	293
	A. Grancharova and T. A. Johansen	
19	Generalized Accelerated Gradient Methods for Distributed MPC Based on Dual Decomposition	309
	P. Giselsson and A. Rantzer	

20 Distributed Multiple Shooting for Large Scale Nonlinear Systems 327
 A. Kozma, C. Savorgnan and M. Diehl

21 Nash-Based Distributed MPC for Multi-Rate Systems 341
 S. Roshany-Yamchi, R. R. Negenborn and A. A. Cornelio

Part II From Large-Scale to Small-Scale: The Decomposed Monolithic System Perspective

22 Cooperative Dynamic MPC for Networked Control Systems 357
 I. Jurado, D. E. Quevedo, K. H. Johansson and A. Ahlén

23 Parallel Implementation of Hybrid MPC. 375
 D. Axehill and A. Hansson

24 A Hierarchical MPC Approach with Guaranteed Feasibility for Dynamically Coupled Linear Systems 393
 M. D. Doan, T. Keviczky and B. De Schutter

25 Distributed MPC Based on a Team Game. 407
 J. M. Maestre, F. J. Muros, F. Fele, D. Muñoz de la Peña and E. F. Camacho

26 Distributed MPC: A Noncooperative Approach Based on Robustness Concepts 421
 G. Betti, M. Farina and R. Scattolini

27 Decompositions of Augmented Lagrange Formulations for Serial and Parallel Distributed MPC 437
 R. R. Negenborn

28 A Hierarchical Distributed MPC Approach: A Practical Implementation 451
 A. Zafra-Cabeza and J. M. Maestre

29 Distributed MPC Based on Agent Negotiation 465
 J. M. Maestre, D. Muñoz de la Peña and E. F. Camacho

30 Lyapunov-based Distributed MPC Schemes: Sequential and Iterative Approaches 479
 J. Liu, D. Muñoz de la Peña and P. D. Christofides

31 Multi-layer Decentralized MPC of Large-Scale Networked Systems 495
C. Ocampo-Martinez, V. Puig, J. M. Grosso and S. Montes-de-Oca

32 Distributed MPC Using Reinforcement Learning Based Negotiation: Application to Large Scale Systems 517
B. Morcego, V. Javalera, V. Puig and R. Vito

33 Hierarchical MPC for Multiple Commodity Transportation Networks 535
J. L. Nabais, R. R. Negenborn, R. B. Carmona-Benítez, L. F. Mendonça and M. A. Botto

34 On the Use of Suboptimal Solvers for Efficient Cooperative Distributed Linear MPC 553
G. Pannocchia, S. J. Wright and J. B. Rawlings

35 Cooperative Distributed MPC Integrating a Steady State Target Optimizer 569
A. Ferramosca, D. Limon and A. H. González

36 Cooperative MPC with Guaranteed Exponential Stability 585
A. Ferramosca

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