Preface

The first part of this volume is a collection of four papers on the fundamental aspects of control. The article by Willems is devoted to an exposition of the behavioral approach to linear discrete-time dynamical systems, with a particular emphasis on developing various representations of sets of trajectories as images and kernels of difference operators. Scherer's paper discusses convex optimization techniques for robust controller synthesis if the underlying generalized plant description has a particular structure and if the uncertainties are captured by integral quadratic constraints. Modeling of physical systems in different domains by conservations laws is the topic of the third paper by Van der Schaft and Maschke in which the authors show how to move from two- to higher-dimensional system networks on the basis of the theory of k-complexes from algebraic topology. The last contribution by Dreesen and de Moor centers around the role of multi-variable polynomial optimization in systems theory and presents algorithms how to solve such problems by realization theory and eigenvalue computations.

In the second part we collected those articles that bridge theoretical developments with technologically advanced applications. In the contribution of Li, de Oliveira and Skelton the authors reveal how to include the selection of sensors and actuators in an convex optimization-based optimal feedback design algorithm, with an illustration of controller synthesis for a flexible beam. Balas, Packard and Seiler suggest linear matrix inequality techniques for modeling frequency-domain uncertainties as they are required in robust controller design, with an application to data sets obtained for the NASA Generic Transport Model aircraft. Viewing feedback controller tuning as a problem of robust estimation is considered by Kinney and de Callafon. They show how their approach can be employed for real-time controller adjustment based on closed-loop measurements and how it applies to an experimental setup for active noise suppression. In the fourth article Van den Hof, Van Doren and Douma are concerned with parameter identifiability if modeling large-scale physical systems on the basis of measurement data, such as required for optimal oil recovery from large reservoirs.

The third part of the book collects articles devoted to applications in motion control and process engineering. Steinbuch, van de Wijdeven, Oomen, van Berkel

and Leenknegt suggest an iterative learning algorithm in order to handle cracks on discs if trying to extract information by optical drive systems. Their experimental results for a Blue Ray device confirm the resulting benefits for recovering data from damaged discs. The article by Tousain and van der Meulen looks into the optimal on-line determination of feed-forward control structures which permits the adaptation to real-time variations in the plant dynamics. Experimental results are described for a wafer-stage and for a digital light projection system in a commercial product. The last two articles address dynamic process control. Kahrs, Brendel, Michalik and Marquardt present their incremental approach to model identification which involves the decomposition of a large system into smaller subsystems for reducing complexity. The modeling approach is demonstrated by experimental results for a semi-batch reactor with a homogeneous liquid reactor content. The book is concluded by a contribution from Jansen, Yortsos, Van Doren and Heidary-Fyrozjaee on the limited controllability of sharp front waves of immiscible two-phase flows in homogenous media. For reservoir engineering they conclude that the presence of heterogeneities in the permeability field is an essential ingredient in order to influence subsurface fluid flows through well-rate manipulation.

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