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Nonlinear Model Predictive Control

Towards New Challenging Applications

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Preface

Model Predictive Control (MPC) is an area in rapid development with respect to both theoretical and application aspects. The former petrochemical applications of MPC were 'easy', in the sense that they involved only a small number of rather similar problems, most of which required only control near steady-state conditions. Further control performance specifications were not very challenging. The improving of technology and control theory enabled the application of MPC in new problems often requiring Nonlinear MPC because of the large transients involved, as it has been already seen even in the chemical process industry for the control of product grade changes. There is now a great interest in introducing MPC in many process and non-process applications such as paper-making, control of many kinds of vehicles, including marine, air, space, road and off-road. Some interesting biomedical applications are also very promising. Finally, the interest in the control of complex systems and networks is significantly increasing.

The new applications frequently involve tight performance specifications, model changes or adaptations because of changing operating points, and, perhaps more significantly, safety-criticality. MPC formulations which offer guarantees of stability and robustness feasibility are expected to be of great importance for the deployment of MPC in these applications. The significant effort in developing efficient solutions of the optimisation problem both using an explicit and a numerical approach is of paramount importance for a wider diffusion of NMPC.

In order to summarize these recent developments, and to consider these new challenges, on September 5-9, 2008, we organized an international workshop entitled "International Workshop on Assessment and Future Directions of Nonlinear Model Predictive Control" (NMPC08) which was held in Pavia, Italy. In the spirit of the previous successful workshops held in Ascona, Switzerland, in 1998, and in Freudenstadt-Lauterbad, Germany in 2005, internationally recognized researchers from all over the world, working in the area of nonlinear model predictive control, were joined together. The number of participants has sensibly increased with respect to the previous editions and 21 countries from 4 continents were represented. The aim of this workshop was to lead to an open and critical exchange of ideas and to lay the foundation for new research directions and future international collaborations, facilitating the practical and theoretical advancement of NMPC technologies.

This volume contains a selection of papers presented at the workshop that cover the following topics: stability and robustness, control of complex systems, state estimation, tracking, control of stochastic systems, algorithms for explicit solution, algorithms for numerical solutions and applications. The high quality of the papers has been guaranteed by a double careful peer-review process.

We would like to thank all authors for their interesting contributions. Likewise, we are grateful to all of the involved reviewers for their invaluable comments.

The workshop and the present volume have been supported by University of Pavia, Risk and Security Study Center of the Institute for Advanced Study (IUSS) and Magneti Marelli.

Lalo Magni
Davide Martino Raimondo
Frank Allgöwer

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