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Advanced Topics in Control Systems Theory

Lecture Notes from FAP 2005

With 33 Figures

Springer

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To our lovely daughters,
AL & EP.

Preface

Advanced Topics in Control Systems Theory is a byproduct of the European school "Formation en Automatique de Paris 2005" (Paris Graduate School on Automatic Control). The school has taken place in spring every year since 2003 and is open to PhD students in control theory throughout Europe. In 2005, the school benefited of the valuable participation of 23 European renowned control researchers and more than 80 European PhD students. While the program consisted of the modules listed below, the contents of the present monograph collects selected notes provided by the lecturers and is by no means exhaustive.

Program of FAP 2005:

P1 Control theory of linear and nonlinear distributed systems
Y. Chitour, E. Trélat

P2 Nonsmooth Analysis and Control Theory
F. Clarke

P3 Efficient methods for linear control and estimation: an algebraic approach
H. Bourles, M. Fliess

P4 Nonlinear optimal control
B. Bonnard

P5 Sampled-data control systems
A. Astolfi, D. Shona-Laila

P6 Nonlinear adaptive control with applications
A. Astolfi, D. Karagianis, R. Ortega

P8 Tools for analysis and control of time-varying systems
A. Loria, E. Panteley

P9 Control of oscillating mechanical systems, synchronization and chaos
J. Levine, H. Nijmeijer

P10 Stability and control of time-delay systems
S. Niculescu, Y. Chitour

P11 On observer design for nonlinear systems
G. Besancon, E. Busvelle

P12 Hybrid systems modeling and control in automotive applications
K.H. Johansson, A. Balluchi, W. Pasillas

P13 Algebraic analysis of multidimensional control systems
J.-F. Pommaret

P14 Geometry of static and dynamic feedback
W. Respondek

As for previous FAP schools each module was taught over 21hrs within one week. Therefore, the contents of the present monograph may be used in support to either a one-term general advanced course on nonlinear control theory, thereby devoting a few lectures to each topic, or it may be used in support to more focused intensive courses at graduate level. The academic requirement for the class student or the reader in general is a basic knowledge on control theory (linear and non linear).

Advanced Topics in Control Systems Theory also constitutes an ideal start for researchers in control theory who wish to broaden their general culture or to get involved in fields different to their expertise, while avoiding a thorough book-keeping. Indeed, the monograph presents in a concise but pedagogical manner diverse aspects of modern control and dynamic systems theory: optimal control, output feedback control, infinite-dimensional systems, systems with delays, sampled-data systems and stability theory. In particular, these lecture notes are based on the material taught in modules P1, P3, P4, P5, P8, P10, and P11.

This is the second of a series of yearly volumes, which shall prevail beyond the lectures taught in class during each FAP season (spring). Further information on FAP, in particular, on the scientific program for the subsequent years is updated on `www.lss.supelec.fr/~loria/FAP2005/Program/` approximately during fall preceeding a FAP season..

FAP is organized within the context of the European teaching network "Control Training Site" sponsored by the European Community through the Marie Curie program. The editors of the present text greatefully acknowledge such sponsorship. We also take this oportunity to acknowledge the French national center for scientific research (C.N.R.S.) which provides us with a working environment and ressources probably unparalleled in the world.

Gif sur Yvette, France.
October 2005

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