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Elena Panteley (Eds.)

Advanced Topics in Control Systems Theory

Lecture Notes from FAP 2005

With 33 Figures

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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 gratefully acknowledge such sponsorship. We also take this opportunity 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.

Contents

List of Contributors	XV
1 Introduction to Nonlinear Optimal Control	
<i>Bernard Bonnard and Jean-Baptiste Caillau</i>	1
1.1 Introduction	1
1.2 Optimal Control and Maximum Principle	2
1.2.1 Preliminaries	2
1.2.2 The Weak Maximum Principle	3
1.2.3 The Maximization Condition	6
1.2.4 Maximum Principle, Fixed Time	6
1.2.5 Maximum Principle, General Case	12
1.2.6 Maximum Principle and Shooting Problem	14
1.2.7 Introduction to the Micro-analysis of the Extremal Solutions	14
1.2.8 Affine Control Systems	15
1.3 More Second-order Conditions	15
1.3.1 High-order Maximum Principle	15
1.3.2 Intrinsic Second-order Derivative and Conjugate Times	21
1.3.3 Examples	37
1.4 Time-optimal Transfer Between Keplerian Orbits	40
1.4.1 Model and Basic Properties	40
1.4.2 Maximum Principle and Extremal Solutions	42
1.4.3 Numerical Resolution	44

1.5 Introduction to Optimal Control with State Constraints	48
1.5.1 The Geometric Framework	50
1.5.2 Necessary Optimality Conditions for Boundary Arcs	51
1.5.3 Junction and Reflection Conditions	53
1.5.4 Proof of the Necessary Conditions in the Riemannian Case	54
Notes and sources	59
References	60

2 Observer Design for Nonlinear Systems

<i>Gildas Besançon</i>	61
2.1 Introduction	61
2.2 Main Problem and Definitions	63
2.2.1 Problem Formulation	63
2.2.2 Conditions for a Solution	65
2.3 Some “Basic” Designs	73
2.3.1 Observer designs for Linear Structures	73
2.3.2 Observer Designs for Nonlinear Structures	76
2.4 Some “Advanced” Designs	80
2.4.1 Interconnection-based Design	80
2.4.2 Transformation-based Design	84
2.5 Conclusion	87
References	87

3 Sampled-data Control of Nonlinear Systems

<i>Dina Shona Laila, Dragan Nešić, Alessandro Astolfi</i>	91
3.1 Introduction	91
3.2 Mathematical Preliminaries	95
3.3 Zero-order-hold Equivalent Models	96
3.4 Motivating Counter-examples	98
3.5 Preliminary Results on Stability and Stabilization	101
3.6 Framework for Controller Design	103
3.6.1 Global Exponential Stabilization	104
3.6.2 Semiglobal Practical Stability	108
3.7 Controller Design within the Framework	110
3.7.1 Emulation	111
3.7.2 Continuous-time Controller Redesign	113

3.7.3 Discrete-time Interconnection and Damping Assignment – Passivity-based Control (IDA-PBC)	115
3.7.4 Backstepping via the Euler Model	121
3.8 Design Examples	126
3.8.1 Jet Engine System	126
3.8.2 Inverted Pendulum	127
3.9 Overview of Related Literature	130
3.10 Open Problems	133
References	134
 4 Stability Analysis of Time-delay Systems:	
A Lyapunov Approach	
<i>Keqin Gu, Silviu-Iulian Niculescu</i>	139
4.1 Introduction	139
4.2 Basic Concepts of Time-delay Systems	141
4.2.1 Systems of Retarded Type	141
4.2.2 Pointwise Delays	142
4.2.3 Linear Systems	142
4.2.4 Characteristic Quasipolynomials	143
4.3 Stability	143
4.4 Some Simple Lyapunov-Krasovskii Functionals	145
4.4.1 Delay-independent Stability	145
4.4.2 Delay-dependent Stability Using Model Transformation	148
4.4.3 Implicit Model Transformation	149
4.5 Complete Quadratic Lyapunov-Krasovskii Functional	151
4.5.1 Analytical Expression	151
4.5.2 Discretization	153
4.6 A Comparison of Lyapunov-Krasovskii Functionals	155
4.7 Dealing with Time-varying Delays	156
4.8 Razumikhin Theorem	159
4.9 Coupled Difference-Differential Equations	161
4.9.1 Introduction	161
4.9.2 Fundamental Solutions	163
4.9.3 Lyapunov-Krasovskii functional	166
4.9.4 Further Comments	167

4.10 Conclusions	168
References	169

5 Controllability of Partial Differential Equations

<i>Yacine Chitour, Emmanuel Trélat</i>	171
5.1 Semigroup Theory, and Cauchy Problems in Banach Spaces	171
5.1.1 Definitions	171
5.1.2 The Cauchy Problem	173
5.1.3 The Nonhomogeneous Initial-value Problem	176
5.2 Controllability and Observability in Banach Spaces	177
5.2.1 A Short Overview on Controllability of Finite-dimensional Linear Control Systems	177
5.2.2 Controllability of Linear Partial Differential Equations in Banach Spaces	178
5.3 Semidiscrete Approximations of Infinite-dimensional Linear Control Systems in Hilbert Spaces	187
5.3.1 Introduction	187
5.3.2 Uniform Controllability of Semidiscrete Approximations of Parabolic Control Systems	189
References	196

6 Stability, Told by Its Developers

<i>Antonio Loría, Elena Panteley</i>	199
6.1 Introduction	199
6.1.1 About the Chapter	199
6.1.2 Stability, Generally Speaking	201
6.2 Lagrange's Stability	203
6.2.1 Modern Interpretations of Lagrange-Dirichlet Stability	207
6.3 Lyapunov's Stability	209
6.3.1 Lyapunov's Methods to Test for Stability	215
6.4 Asymptotic Stability	219
6.5 Globalisation of Asymptotic Stability	222
6.5.1 Global, <i>i.e.</i> in the <i>Large</i> or in the <i>Whole</i> ?	223
6.5.2 Asymptotic Stability in the Large	224
6.5.3 Asymptotic Stability in the Whole	226
6.5.4 An Illustrative Example	229

6.6 On the Trace of “Krasovskiĭ-La Salle’s Theorem”	232
6.6.1 Autonomous Systems	232
6.6.2 Time-varying Periodic Systems	234
6.7 Uniformity	236
6.7.1 Uniform Stability	237
6.7.2 Uniform Global Stability	238
6.7.3 Uniform Asymptotic Stability	239
6.7.4 Uniform Asymptotic Stability in the Large	241
6.7.5 Uniform Asymptotic Stability in the Whole	242
6.8 Stability with Respect to Perturbations	245
6.9 Further Bibliographical Remarks	251
6.10 Conclusions	254
References	255

7 Structural Properties of Linear Systems – Part II: Structure at Infinity

<i>Henri Bourlès</i>	259
7.1 Introduction	259
7.2 Differential Polynomials and Non-commutative Formal Series	259
7.2.1 Differential Polynomials: A Short Review	259
7.2.2 Local Complete Rings	260
7.2.3 Formal Power Series	260
7.2.4 A Canonical Cogenerator	261
7.2.5 Matrices over $\mathbf{S}$	262
7.2.6 Formal Laurent Series	264
7.3 Transmission Poles and Zeros at Infinity	265
7.3.1 Transfer Matrix of an Input-Output System	265
7.3.2 Structure at Infinity of a Transfer Matrix	266
7.4 Impulsive Systems and Behaviors	268
7.4.1 Temporal Systems	268
7.4.2 A Key Isomorphism	270
7.4.3 Impulsive Behavior	271
7.4.4 Impulsive System	272
7.4.5 Generalization of the Notion of Temporal System	275

7.5 Poles and Zeros at Infinity277

 7.5.1 Uncontrollable Poles at Infinity278

 7.5.2 System Poles at Infinity278

 7.5.3 Hidden Modes at Infinity279

 7.5.4 Invariant Zeros at Infinity281

 7.5.5 System Zeros at Infinity281

 7.5.6 Relations between the Various Poles and Zeros at Infinity281

7.6 Concluding Remarks282

7.7 *errata* and *addenda* for [7]282

References283

**A On the Literature’s Two Different Definitions of Uniform
Global Asymptotic Stability for Nonlinear Systems**

Andrew R. Teel, Luca Zaccarian285

A.1 Different UGAS Definitions285

A.2 A Locally Lipschitz (Uniform-in-time) System that is ULS and
 UGA but not UGB286

References288