

Lecture Notes
in Control and Information Sciences

328

Editors: M. Thoma · M. Morari

Antonio Loría · Françoise Lamnabhi-Lagarrigue
Elena Panteley (Eds.)

Advanced Topics in Control Systems Theory

Lecture Notes from FAP 2005

With 33 Figures

 Springer

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Editors

Dr Antonio Loría, PhD
Dr Françoise Lamnabhi-Lagarrigue, PhD
Dr Elena Panteley, PhD
Laboratoire des Signaux et Systèmes
Centre National de la Recherche Scientifique (CNRS)
SUPELEC
3 rue Joliot Curie
91192 Gif-sur-Yvette
France

British Library Cataloguing in Publication Data

Advanced topics in control systems theory : lecture notes from FAP 2005. -

(Lecture notes in control and information sciences ; 328)

1. Automatic control - Congresses 2. Automatic control - Mathematical models - Congresses

3. Control theory - Congresses 4. Systems engineering - Congresses

I.Loria, A. (Antonio) II.Lamnabhi-Lagarrigue, F. (Francoise), 1953-

III.Panteley, E. (Elena) IV.FAP 2005

(Graduate school . 2005 : Paris)

629.8'312

ISBN-13 9781846283130

ISBN-10 1846283132

Library of Congress Control Number: 2005938387

Lecture Notes in Control and Information Sciences ISSN 0170-8643

ISBN-10: 1-84628-313-2

Printed on acid-free paper

ISBN-13: 978-1-84628-313-0

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Typesetting: Data conversion by authors.

Final processing by PTP-Berlin Protago-TeX-Production GmbH, Germany

Cover-Design: design & production GmbH, Heidelberg

Printed in Germany

9 8 7 6 5 4 3 2 1

Springer Science+Business Media
springer.com

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 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.

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List of Contributors

A. Astolfi

Department of Electrical and
Electronic Engineering, Imperial
College,
Exhibition Road, London SW7
2BT, UK.
a.astolfi@imperial.ac.uk

G. Besançon

Laboratoire d'Automatique de
Grenoble,
Ecole Nationale Supérieure des
Ingénieurs Electriciens de Grenoble
B.P. 46, 38402 St. martin d'Hères,
Cedex, France.
Gildas.Besancon@inpg.fr

B. Bonnard

Institut de Mathématiques de
Bourgogne, UMR CNRS 5584,
B.P 47870, 21078 Dijon Cedex,
France.
bbonnard@u-bourgogne.fr

H. Bourlès

SATIE, ENS de Cachan et CNAM,
61 Ave du Président Wilson,
94230 Cachan, France.
henri.bourles@satie.ens.cachan.fr

J.-B. Caillau

ENSEEIH-IRIT, UMR CNRS
5505, 2 rue Camichel,
31071 Toulouse, France.
caillau@n7.fr

Y. Chitour

Laboratoire des Signaux et
Systèmes,
Université Paris-Sud, C.N.R.S.,
Supélec,
3, Rue Joliot Curie, 91192
Gif-sur-Yvette, France.
chitour@lss.supelec.fr

K. Gu

Department of Mechanical and
Industrial Engineering,
Southern Illinois University
Edwardsville, Edwardsville,
Illinois 62026-1805, USA
kgu@siue.edu

A. Loria

C.N.R.S., Laboratoire des Signaux
et Systèmes, Supélec,
3, Rue Joliot Curie, 91192
Gif-sur-Yvette, France.
loria@lss.supelec.fr

E. Panteley

C.N.R.S., Laboratoire des Signaux
et Systèmes, Supélec,
3, Rue Joliot Curie, 91192
Gif-sur-Yvette, France.
panteley@lss.supelec.fr

D. Nešić

Department of Electrical and
Electronic Engineering,
The University of Melbourne,
Parkville, VIC 3001, Australia
d.nesic@ee.unimelb.edu.au

S. Niculescu

C.N.R.S., HEUDIASYC,
Centre de Recherches de Royallieu
BP 20529 - 60205 Compiègne
CEDEX, France
niculescu@hds.utc.fr

D. Shona-Laila

Department of Electrical and
Electronic Engineering, Imperial
College,

Exhibition Road, London SW7
2BT, UK.
d.laila@imperial.ac.uk

A. Teel

Department of Electrical and
Computer Engineering, University
of California, Santa Barbara, CA
93106, USA. teel@ece.ucsb.edu

E. Trélat

Laboratory AN-EDP, CNRS UMR
8628,
Université Paris-Sud
Orsay, France.
emmanuel.trelat@math.u-psud.fr

L. Zaccarian

Dipartimento di Informatica,
Sistemi e Produzione,
University of Rome, Tor Vergata,
00133 Rome, Italy
zack@disp.uniroma2.it