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LECTURE NOTES IN CONTROL
AND INFORMATION SCIENCES

294

Luca Benvenuti
Alberto De Santis
Lorenzo Farina (Eds.)

Positive Systems

Proceedings of the First Multidisciplinary
International Symposium on Positive Systems:
Theory and Applications (POSTA 2003),
Rome, Italy, August 28–30, 2003.



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in Control and Information Sciences 294

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Flumina pauca vides de magnis fontibus orta:
plurima collectis multiplicantur aquis

Publius Ovidius Naso, *Remedia amoris*

Preface

Mathematical modelling is concerned with choosing the relevant variables of the phenomenon at hand and revealing the relationships among those. *Positivity* of the variables often emerges as the immediate consequence of the nature of the phenomenon itself. A huge number of evidences are just before our eyes: any variable representing any possible type of resource measured by a quantity such as time, money and goods, buffer size and queues, data packets flowing in a network, human, animal and plant populations, concentration of any conceivable substance you may think of and also – if you haven't conceived this - mRNAs, proteins and molecules, electric charge and light intensity levels. Moreover, also probabilities are positive quantities, so one should also mention in this list any model such as hidden Markov models and phase-type distributions models.

Positive Systems are dynamical systems whose state variables are positive (or at least nonnegative) in value at all times. Such systems have the peculiar property that any nonnegative input and nonnegative initial state generate a nonnegative state trajectory and output at all times.

Positive systems have a long and rich history with antecedents in the work of Markov, Perron and Frobenius, Leontieff and Leslie, just to mention a few. The unifying approach of system theory was initiated in the 80's by David Luenberger in his celebrated book *Introduction to Dynamic Systems: Theory, Models and Applications*. Chapter VI of his text is devoted to the theory and applications of positive systems. Indeed, to quote Luenberger:

*It is for positive system that dynamic systems theory
assumes one of its most potent forms.*

From that time on, an impressive number of theoretical and applicative contributions to this field has appeared.

This volume contains the proceedings of the *First Multidisciplinary Symposium on Positive Systems: Theory and Applications (POSTA 2003)* held in Rome, Italy, on August 28-30, 2003. The Symposium aimed to join together researchers working in different areas related to positive systems, in

VIII Preface

order to provide a multidisciplinary forum where they could have the opportunity of exchange ideas and compare results in a unifying framework. The contributions actually well served this aim since they addressed key cross-cutting issues of relevance to most thematic areas of positive systems theory and applications.

We wish to thank the Program Committee for the outstanding work in reviewing the papers thus providing a substantial contribution to the improvement of the quality of the Symposium. Furthermore, we wish to thank the IEEE Control Systems Society and A.N.I.P.L.A. for their technical sponsorship, and especially all the participants to POSTA 2003 for making this meeting a success. In fact, as Ovid said: *the rivers are not very broad near their source: it is the little tributaries that make them wide.*

The final remark is dedicated to Professors David Luenberger and Jan van Schuppen for their availability, support to the initiative and for enriching the Symposium with their inspired lectures.

Roma
August 2003

Luca Benvenuti
Alberto De Santis
Lorenzo Farina

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Contents

ABSTRACTS OF PLENARY TALKS

Positive Random Systems with Application to Investment
David G. Luenberger 1

Rational Positive Systems for Reaction Networks
Jan H. van Schuppen 3

INVITED SESSION

Max-plus Algebra
Organizer: L. Hardouin

**Min-plus and Max-plus System Theory Applied to
Communication Networks**
Jean-Yves Le Boudec, Patrick Thiran 7

Reachability and Invariance Problems in Max-plus Algebra
Stéphane Gaubert, Ricardo Katz 15

Modelling of Urban Bus Networks in Dioids Algebra
Sébastien Lahaye, Laurent Houssin, Jean-Louis Boimond 23

Modal Logic and Dioids
Christiano P. Pessanha, Rafael Santos-Mendes 31

Monotone Linear Dynamical Systems over Dioids
Laurent Truffet 39

**Optimal Control for (max,+)-linear Systems in the Presence
of Disturbances**
Mehdi Lhommeau, Laurent Hardouin, Bertrand Cottenceau 47

INVITED SESSION

Continuous and Hybrid Petri Nets*Organizers: A. Giua and M. Silva*

Unforced Continuous Petri Nets and Positive Systems
Manuel Silva, Laura Recalde 55

Reachability Graph for Autonomous Continuous Petri Nets
René David, Hassane Alla 63

Modeling Hybrid Positive Systems with Hybrid Petri Nets
Marco Gribaudo, András Horváth 71

Simulation and Control of a Bottling Plant using First-order Hybrid Petri Nets
Roberta Armosini, Alessandro Giua, M. Teresa Pilloni, Carla Seatzu ... 79

INVITED SESSION

Modelling and Identification of Biological Systems*Organizer: M. Saccomani*

Parameter Identifiability of Nonlinear Biological Systems
Mariapia Saccomani, Stefania Audoly, Giuseppina Bellu, Leontina D'Angiò 87

Towards Whole Cell “in Silico” Models for Cellular Systems: Model Set-up and Model Validation
Andreas Kremling, Katja Bettenbrock, Sophia Fischer, Martin Ginkel, Thomas Sauter, Ernst Dieter Gilles 95

Guaranteed Parameter Estimation for Cooperative Models
Michel Kieffer, Eric Walter 103

Modeling and Simulation of Genetic Regulatory Networks
Hidde de Jong 111

Qualitative Analysis of Regulatory Graphs: a Computational Tool Based on a Discrete Formal Framework
Claudine Chaouiya, Elisabeth Remy, Brigitte Mossé, Denis Thieffry ... 119

A Reconstruction Algorithm for Gene Regulatory Sparse Networks using Positive Systems
Ilaria Mogno 127

INVITED SESSION

Positive Modelling and Control of Biological Systems*Organizers: G. Bastin and J.L. Gouzé*

The Basic Reproduction Number in a Multi-city Compartmental Epidemic Model
Julien Arino, Pauline van den Driessche 135

Stability Analysis of a Metabolic Model with Sequential Feedback Inhibition
Yacine Chitour, Frédéric Gognard, Georges Bastin 143

Differential Systems with Positive Variables
Jean-Luc Gouzé 151

Positivity and Invariance Properties of Nonisothermal Tubular Reactor Nonlinear Models
Mohamed Laabissi, Mohamed E. Achhab, Joseph J. Winkin, Denis Dochain 159

A Feedback Perspective for Chemostat Models with Crowding Effects
Patrick De Leenheer, David Angeli, Eduardo D. Sontag 167

Positive Control for a Class of Nonlinear Positive Systems
Ludovic Mailleret 175

Competitive and Cooperative Systems: a Mini-review
Morris W. Hirsch, Hal L. Smith 183

INVITED SESSION

Positivity and Stability*Organizer: T. Damm*

Small-gain Theorems for Predator-prey Systems
Patrick De Leenheer, David Angeli, Eduardo D. Sontag 191

Positive Particle Interaction
Ulrich Krause 199

Stability of Linear Systems and Positive Semigroups of Symmetric Matrices
Tobias Damm 207

INVITED SESSION

Nonnegative Matrices*Organizers: R. Bru and V. Rumchev***Digraph-based Conditioning for Markov Chains***Stephen J. Kirkland* 215**Paths and Cycles in the Totally Positive Completion Problem***Cristina Jordán, Juan R. Torregrosa* 217**Completion Problems for Positive Matrices with Minimal Rank***Rafael Cantó, Ana M. Urbano* 225

INVITED SESSION

Reachability and Controllability*Organizers: V. Rumchev and R. Bru***Some Problems about Structural Properties of Positive Descriptor Systems***Rafael Bru, Carmen Coll, Sergio Romero-Vivo, Elena Sánchez* 233**Positive Linear Systems Reachability Criterion in Digraph Form***Ventsi G. Rumchev* 241**A Characterization of Reachable Positive Periodic Descriptor Systems***Begoña Cantó, Carmen Coll, Elena Sánchez* 249**A PLDS Model of Pollution in Connected Water Reservoirs***Snezhana P. Kostova* 257

CONTRIBUTED PAPERS

Positivity for Matrix Systems: a Case Study from Quantum Mechanics*Claudio Altafini* 265**A Simple Food Chain Model with Delay***Mario Cavani, Saël Romero* 273**Linear Positive Systems and Phase-type Representations***Christian Commault* 281**Blending Positive Matrix Pencils with Economic Models***Teresa P. de Lima* 289**On the Positive Reachability of 2D Positive Systems***Ettore Fornasini, Maria Elena Valcher* 297**On Nonnegative Realizations***Karl-Heinz Förster, Béla Nagy* 305**Estimation and Strong Approximation of Hidden Markov Models***László Gerencsér, Gábor Molnár-Sáska* 313**A Paradigm for Derivatives of Positive Systems***Bernd Heidergott* 321**Nonlinear Positive 2D Systems and Optimal Control***Dariusz Idczak, Marek Majewski* 329**State Feedback Set Stabilization for a Class of Nonlinear Systems***Lars Imstrand, Bjarne A. Foss* 337**Some Recent Developments in Positive 2D Systems***Tadeusz Kaczorek* 345**Nonnegative Infinite Hankel Matrices having a Finite Rank***Andrea Morettin* 353**The Character of an Idempotent-analytic Nonlinear Small Gain Theorem***Henry G. Potrykus, Frank Allgöwer, S. Joe Qin* 361**Positive Systems with Nondecreasing Controls. Existence and Well-posedness***Stanisław Walczak, Dariusz Idczak* 369**Reachability and Controllability of Positive Linear Discrete-time Systems with Time-delays***Guangming Xie, Long Wang* 377**Countercurrent Double-pipe Heat Exchangers are a Special Type of Positive Systems***Arturo Zavala-Río, Ricardo Femat, Ricardo Romero-Méndez* 385**Note on Structural Properties and Sizes of Eigenspaces of Min-max Functions***Qianchuan Zhao, Da-Zhong Zheng* 393