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Positive Systems

**Proceedings of the First Multidisciplinary
International Symposium on Positive Systems:
Theory and Applications (POSTA 2003),
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With 43 Figures



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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

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
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Contents

ABSTRACTS OF PLENARY TALKS

Positive Random Systems with Application to Investment	
<i>David G. Luenberger</i>	1
Rational Positive Systems for Reaction Networks	
<i>Jan H. van Schuppen</i>	3

INVITED SESSION

Max-plus Algebra

Organizer: L. Hardouin

Min-plus and Max-plus System Theory Applied to Communication Networks	
<i>Jean-Yves Le Boudec, Patrick Thiran</i>	7
Reachability and Invariance Problems in Max-plus Algebra	
<i>Stéphane Gaubert, Ricardo Katz</i>	15
Modelling of Urban Bus Networks in Dioids Algebra	
<i>Sébastien Lahaye, Laurent Houssin, Jean-Louis Boimond</i>	23
Modal Logic and Dioids	
<i>Christiano P. Pessanha, Rafael Santos-Mendes</i>	31
Monotone Linear Dynamical Systems over Dioids	
<i>Laurent Truffet</i>	39
Optimal Control for $(\max,+)$-linear Systems in the Presence of Disturbances	
<i>Mehdi Lhommeau, Laurent Hardouin, Bertrand Cottenceau</i>	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 Piloni, 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 Grogard, 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, Sael Romero 273

Linear Positive Systems and Phase-type Representations

Christian Commault 281

Blending Positive Matrix Pencils with Economic Models	
<i>Teresa P. de Lima</i>	289
On the Positive Reachability of 2D Positive Systems	
<i>Ettore Fornasini, Maria Elena Valcher</i>	297
On Nonnegative Realizations	
<i>Karl-Heinz Förster, Béla Nagy</i>	305
Estimation and Strong Approximation of Hidden Markov Models	
<i>László Gerencsér, Gábor Molnár-Sáska</i>	313
A Paradigm for Derivatives of Positive Systems	
<i>Bernd Heidergott</i>	321
Nonlinear Positive 2D Systems and Optimal Control	
<i>Dariusz Idczak, Marek Majewski</i>	329
State Feedback Set Stabilization for a Class of Nonlinear Systems	
<i>Lars Imsland, Bjarne A. Foss</i>	337
Some Recent Developments in Positive 2D Systems	
<i>Tadeusz Kaczorek</i>	345
Nonnegative Infinite Hankel Matrices having a Finite Rank	
<i>Andrea Morettin</i>	353
The Character of an Idempotent-analytic Nonlinear Small Gain Theorem	
<i>Henry G. Potrykus, Frank Allgöwer, S. Joe Qin</i>	361
Positive Systems with Nondecreasing Controls. Existence and Well-posedness	
<i>Stanisław Walczak, Dariusz Idczak</i>	369
Reachability and Controllability of Positive Linear Discrete-time Systems with Time-delays	
<i>Guangming Xie, Long Wang</i>	377
Countercurrent Double-pipe Heat Exchangers are a Special Type of Positive Systems	
<i>Arturo Zavala-Río, Ricardo Femat, Ricardo Romero-Méndez</i>	385
Note on Structural Properties and Sizes of Eigenspaces of Min-max Functions	
<i>Qianchuan Zhao, Da-Zhong Zheng</i>	393
Author Index	401