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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
Alberto De Santis
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