

# Preface

When beginning the project of this book, we were wondering why the community would be interested in reading it knowing that constrained control or limited input is a field of abundant and various result papers and books. But, as the project was evolving and the chapters contents making precise, we guessed and hoped that the book would be read for the facts we try to clarify as follows: First, the book has as a leading line the problem of constraints on the inputs which is widely studied these last years but presents also different related problems in control of such systems. Further, the book attempts to gather all the recent results about constrained inputs that are becoming essential for practical reasons more than theoretical ones. Moreover, we are interested in another kind of constraints, namely rate or increment limitations that are becoming very challenging in control applications. Furthermore, we tried in this book to present all eventual cases that may face an engineer or a researcher in an application of control for constrained input systems. It can be quoted that in the presence of limitations, one may be asked to deal with uncertainties, non-measurable states, singularities, delay, two dimension systems, etc. Hence, we will present the robustness of the obtained feedback controllers, the use of observers or output feedback. We will also handle the problem of singular systems and delay systems when the inputs are limited within given sets. Two-dimensional systems, commonly known as 2D systems, will also be studied.

The aim of this book is to give an overview of all the works developed in our team related to constrained control over last two decades. Major differences about this book and works treating the problem of constrained inputs are as follows: First, the constraints on increment or rate of control are introduced. The increment or rate constraints are not nested as it is studied in similar works but both constraints, on the input and its increment or rate, are in parallel. Second, positive invariance-based results are given leading to algebraic conditions that are easy to check but with a trials and error procedure. As presented, linear programming may be used to overcome this withdrawing. Another way for avoiding this problem is the introduction of LMI conditions. In fact, in this case with the given conditions, the

stabilization problems become feasibility problems easily checked with the available software's like MATLAB. For both cases of handling constrained control and as it is the vein of all constrained control methods, the enlargement of initial condition set is obtained. Third and not lastly as a second part, convex writing of the closed-loop system having constraints on the input, introduced in the recent literature, will be also used leading to LMI conditions to design stabilizing controllers for such systems.

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