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# STABILIZATION OF POSITIVE SWITCHING LINEAR DISCRETE-TIME SYSTEMS

Abdellah Benzaouia[1] and Fernando Tadeo[2]

[1]Department of Physics
Faculty of Sciences Semlalia
University Cadi Ayyad
B.P. 2390, Marrakech 40000, Morocco
benzaouia@ucam.ac.ma

[2]Departamento de Ingenieria de Sistemas y Automatica
Universidad de Valladolid
Paseo Prado de la Magdalena, 47005 Valladolid, Spain
fernando@autom.uva.es

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Abstract. *The problem of stabilizing controlled positive discrete-time switching systems by state and output feedback control is solved in this paper. Necessary and sufficient conditions are given for the existence of controllers that stabilize switching systems while keeping the states nonnegative. These conditions are proposed under LMI form, so they can be used directly in the synthesis phase. Examples composed of three subsystems are studied to show the applicability of the proposed techniques.*
**Keywords:** Switching systems, Positive systems, Asymptotic stability, State feedback, Output feedback

## 1. Notation.

- $P > 0$ stands for a positive definite matrix $P$.
- $A \succeq 0$ stands for a *positive* matrix $A$, that is, a matrix with nonnegative elements: $a_{ij} \geq 0$.
- For two vectors $x, y \in \mathbb{R}^n$, $x \preceq y$ if $x_i \preceq y_i, i = 1, \ldots, n$.

## 2. Introduction.

Switched systems are a class of hybrid systems found in the practical situations that involve different modes of operation (corresponding to different subsystems) [1]. For example, many processes in the chemical and pharmaceutical industries operate following batches, composed of different operations that are carried out in sequence. This changes discontinuously the dynamics of the operation [2]. In manufacturing, hybrid switched systems are found in steel rolling mills [3], used for producing thin metal sheets, following several steps based on pressing the metal strip with rolling cylinders: the dynamics are known to change at each pass due to the variation in thickness [4]. Many other examples can be found in the automotive industry, in aircraft and air traffic control, and many other fields.

From a mathematical point of view, a switching system consists of a family of subsystems and a set of rules that defines the switchings [1]. According to the classification given in [5] and [6], two main problems have been studied in the literature: the first is to obtain testable conditions that guarantee asymptotic stability under arbitrary switching rules [7], [8]; the second is to determine a switching sequence that renders the switched system asymptotically stable (see [1], [9] and references therein).