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# Stability of switched linear systems with possible Zeno behavior: a polytopic approach.

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## Abstract

This paper deals with the stability of switched linear systems under arbitrary switching sequences. To do this we approximate a switched system by a special case of a polytopic system. This is extended to the study of infinitely fast (or Zeno) switching by a statistical argument that makes possible to predict the behavior of the states of the system with probability one (w.p.1). From here, Lyapunov's theory is used to obtain Linear Matrix Inequality (LMI) restrictions to test stability of the system. These conditions include, as a special case, the Common Quadratic Lyapunov Function (CQLF) criterion and, therefore, are less restrictive although still easy to implement in any specialized LMI software. The paper is complemented with the study of a recurrent example on the area that does not accept a CQLF but it is stable nevertheless. Further examples including Zeno behavior of the system are also presented.

*Keywords:* Switched Systems, Zeno effect, Linear Matrix Inequalities, Polytopic systems, Lyapunov function

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## 1. Introduction

Switched linear systems can be interpreted as a special case of hybrid systems [1]. They have been widely studied and many results may be found in the book [2]. Other examples are the papers [3, 4], and more recently, [5, 6], where conditions for global asymptotic stability of discrete and continuous time systems are developed considering dwell time. In [7] stability for a particular case with two discrete states is studied, while in [8] the problem of continuous state feedback and pole allocation is addressed by imposing a Common Quadratic Lyapunov

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