

EXPONENTIAL STABILITY ANALYSIS FOR DISCRETE-TIME SWITCHED LINEAR SYSTEMS WITH TIME-DELAY

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ABSTRACT. *In this paper, we focus on the problem of stability for a class of discrete-time switched linear systems with time-delay. The average dwell time method is introduced into discrete switched delay systems for the first time. Sufficient conditions for exponential stability are developed for a class of switching signal with average dwell time. These conditions are given in terms of linear matrix inequalities (LMIs). As a special case of such a switching signal, we can obtain exponential stability under arbitrary switching signal. The state decay estimate is also explicitly developed. Lastly, a numerical example is given to illustrate the effectiveness of the proposed method.*

Keywords: Switched delay systems, Exponential stability, Average dwell time, Switching signal, Linear matrix inequalities (LMIs)

1. Introduction. Switched systems have drawn considerable attention in recent years. This is mainly because many practical systems, for example, chemical transportation and robot manipulators can be modelled as switched systems [1, 2]. One of the key issues in the study of switched systems is stability analysis [3-8]. The existing methods for this problem are common Lyapunov function method, multiple Lyapunov function method and average dwell time method and so on (see, for example [3, 4, 9-12]). Common Lyapunov function is conservative and most switched systems do not possess a common Lyapunov function. Multiple Lyapunov function method and average dwell time method are effective tools for stability study of switched systems. Multiple Lyapunov function method seems to be more general but the non-increasing condition of a Lyapunov-like function on "switched on" time sequence is hard to satisfy or to check. The average dwell time method does not need this non-increasing condition and gives explicit bounds of average dwell time when stability is assured. Also, the average dwell time method provides a condition that a class of switching laws satisfy.

On the other hand, time-delay is a common phenomenon in practical engineering control design. During the past decades, the problems of stability and stabilizability of systems with time delay have received much attention (see, for example, [13-18]). Switched systems with time delays are referred to as switched delay systems, which are a brand new type of systems [19-21]. Due to the interaction between continuous dynamics and discrete dynamics and the impact of time delays, the behavior of switched delay systems is usually much more complicated. Some methods that are used to study switched systems are