

DELAY-DEPENDENT STABILITY CRITERION AND H_∞ STATE-FEEDBACK CONTROL FOR UNCERTAIN DISCRETE-TIME SWITCHED SYSTEMS WITH TIME-VARYING DELAYS

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ABSTRACT. *The robust stability and H_∞ state-feedback control problems for uncertain discrete-time switched systems with time-varying delays are discussed in this paper. The uncertainty is time-varying but norm-bounded. By the switched Lyapunov-Krasovskii functional approach, delay-dependent linear matrix inequality conditions for the delay-varying discrete-time uncertain switched system are developed to guarantee that the switched system is asymptotically stable with an l_2 gain smaller than a prescribed scalar under arbitrary switching; Switched state-feedback controller is designed to render the corresponding switched closed-loop system asymptotically stable with an l_2 gain measure. Linear matrix inequality approach is employed to the state-feedback controller design. Finally, two numerical examples are given to illustrate the validity of the proposed techniques.*

Keywords: Discrete-time switched systems, Time-varying delays, Norm-bounded uncertainties, Switched Lyapunov function, Linear matrix inequality (LMI)

1. Introduction. In the past decades, the study of switched systems has been received considerable attention. Switched system is a class of hybrid system consisting a family of subsystems and a rule orchestrating the switching between the subsystems, which can be model many physical or man-made systems displaying feature of switching. The stability problem, caused by various switching, is the main concern in the field of switched systems and many methodologies have been used in the study of switched systems. Two basic issues have been addressed in literature, i.e., the stability under arbitrary switching signals and the stability under constrained switching signals. The former case is mainly investigated based on constructing a common Lyapunov function or a switched Lyapunov function which is an improve approach in discrete-time domain [1]. The last case is investigated by multiple Lyapunov function approach [2-5]. For the main result on switched systems, we refer readers to Liberzon and Morse [6], DeCarlo [7] and Sun and Ge [8] and the references therein.

On another research front, time delays and parameter uncertainties, which are inherent features of many physical process, are great source of instability and poor performance. Therefore, much attention has been devoted to the study of many kinds of uncertain systems with time delays [9-13]. To switched systems, a great number of results have been reported in the literature, such as stability analysis [1,14,15], H_∞ state-feedback control [16-19], H_∞ output-feedback control [20-23], $l_2 - l_\infty$ control [24,25], H_∞ filtering design [25-30] and the references therein. For the discrete-time case, the robust stability and stabilization of linear switched systems with polytopic uncertainties are obtained in [27].