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Robust Admissibility Analysis of Switched Singular Systems with Linear Fractional Uncertainties

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Abstract. This paper considers the problem of robust admissibility analysis of uncertain discrete-time switched linear singular systems for arbitrary switching laws. The parameter uncertainties are assumed to be of linear fractional form. By using the switched Lyapunov function approach, some new sufficient conditions ensuring such systems to be admissible for arbitrary switching laws are presented in terms of linear matrix inequalities (LMIs). Example is provided to demonstrate the effectiveness of the obtained results

Introduction

Recently, switched systems have received increasing attention because the study for such systems is not only academically challenging, but also of practical importance [1]. A survey of basic problems in stability and design of switched systems has been proposed in [2]. As pointed out in [2], one of the interesting problems in switched systems is to find non (or less)-conservative conditions to guarantee the stability of the systems for arbitrary switching laws. A powerful tool regarding this issue is the multiple Lyapunov functions (MLF) approach [2-4], where an individual decrescent Lyapunov function is constructed for each subsystem. The switched Lyapunov function (SLF) approach proposed in [5] essentially belongs to MLF approach. Since the SLF is required to be decrescent between two adjacent subsystems, it can be considered as a tradeoff between those conservative methodologies (using a single common Lyapunov function) and the ones less conservative but numerically hard to be checked.

As is well known, singular systems (also known as descriptor systems), whose behaviors are governed by both differential equations and algebraic equations, have high abilities in representing the dynamics of many practical systems [6]. Over the past two decades, there has been extensive study on singular systems [7-9]. Switched linear singular (SLS) systems are suitable models for many natural and man-made phenomena, for example, dynamic economic systems, electrical networks and robotics [10-11]. Therefore, it is important to study the SLS systems. Since the regularity, impulse elimination, state consistence and stability should be considered simultaneously, the analysis and synthesis of the SLS systems are more complicated than those of regular systems. Recently, some basic research results on such systems have been given in [12-16]. In [12] and [13], the admissible control of continuous-and discrete-time SLS systems for arbitrary switching laws are considered, respectively. In [14] and [15], the stability analysis for a special kind of continuous- and discrete-time SLS systems with commutative pairwise of descriptor matrix and system matrices under arbitrary switching are discussed, respectively. In [16], the admissibility analysis and control of uncertain discrete-time SLS systems are investigated. However, it is noted that all the above-mentioned works are based on a common Lyapunov function method, which tends to give more conservative conditions.

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