

DELAY-DEPENDENT ROBUST EXPONENTIAL STABILITY OF UNCERTAIN SINGULAR SYSTEMS WITH TIME DELAYS

ZHENG GUANG WU, HONGYE SU AND JIAN CHU

National Laboratory of Industrial Control Technology
Institute of Cyber-Systems and Control
Zhejiang University
Zhejiang University Yuquan Campus, Hangzhou, 310027, P. R. China
nashwzhg@126.com; { hysu; jchu }@iipc.edu.cn

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ABSTRACT. *The problem of delay-dependent robust exponential stability is investigated for uncertain singular systems with state delay. In terms of linear matrix inequality (LMI) approach, some improved delay-dependent conditions are presented to ensure the considered system to be regular, impulse free and exponentially stable via an augmented Lyapunov functional and tighter integral inequalities. Numerical examples are given to illustrate the effectiveness and the benefits of the proposed methods.*

Keywords: Singular systems, Time-delay systems, Delay-dependent, Exponential stability, Linear matrix inequality (LMI)

1. **Introduction.** In the past decades, much attention has been paid to the study of singular systems, because singular systems can better describe physical systems than regular ones and have extensive applications in electrical circuits, power systems, economics and other areas [1]. The control problems related to singular systems are important both in theory and practice, and many important and interesting results have been proposed in terms of all kinds of approaches. For more details on singular systems, we refer the readers to [1, 2, 3, 4, 5] and the references therein.

Recently, more and more attention has been devoted to the stability problem of singular systems with time-delay due to the fact that time delays inevitably exist in a variety of practical systems, such as chemical processes, nuclear reactors, biological systems, etc., and lead to the instability and poor performance of systems [6, 7, 8, 9]. It should be pointed out that the stability problem for singular systems is much more complicated than that for regular systems because it requires to consider not only stability, but also regularity and absence of impulses (for continuous singular systems) or causality (for discrete singular systems) simultaneously, while the latter two do not arise in the regular ones [3]. Very recently, more attention has been paid to the study on delay-dependent stability of singular time-delay systems due to the fact that the delay-independent conditions are usually more conservative than the delay-dependent conditions, especially when the time delay is comparatively small. The delay-dependent stability problem was considered in [10, 11, 12] via linear matrix inequality (LMI) approach and several stability conditions were established. To reduce the conservatism of the stability results, [13, 14, 15] made use of the free-weighting matrix method [16, 17, 18, 19, 20] to proposed some improved delay-dependent stability conditions. However, it should be mentioned that the decomposition of the original singular system is used in [11, 13], which makes the system analysis complicated, and the results of [10, 12, 14, 15] are all formulated in terms of non-strict LMIs, whose solutions are difficult to calculate since equality constraints are often fragile