AN IMPROVED H_∞ STABILIZATION CONDITION FOR SINGULAR TIME-DELAY SYSTEMS

Yi-Fu Feng[1], Xun-Lin Zhu[2,*] and Qing-Ling Zhang[1]

[1]Institute of Systems Science
Northeastern University
Shenyang, Liaoning, 110004, P. R. China
yf19692004@163.com, qlzhang@mail.neu.edu.cn

[2]School of Computer Science and Communication Engineering
Zhengzhou University of Light Industry
Zhengzhou, Henan, 450002, P. R. China
*Corresponding author: hntjxx@163.com

ABSTRACT. *This paper studies the problem of H_∞ stabilization for singular time-delay systems. By eliminating redundant variables, a simplified H_∞ stability condition is derived, and an improved H_∞ stabilization method is proposed on the basis of introducing a tuning parameter. Compared with the existing results, the newly obtained H_∞ stabilization condition is less conservative and less complex. An example is given to illustrate the effectiveness and the merits of the proposed methods.*
Keywords: Singular systems, Time delay, H_∞ control

1. **Introduction.** Over the past decades, much attention has been focused on the stability analysis and controller synthesis for time-delay systems (see [1, 2, 7]) and singular linear time-delay systems (see [3]) due to the fact that the singular system model is a natural presentation of dynamic systems and it can describe a large class of systems than regular ones, such as large-scale systems, power systems and constrained control systems. Just like state-space time-delay systems, the results on stability analysis and stabilization for singular time-delay systems can be classified into two categories, that is, delay-independent criteria [4, 5] and delay-dependent ones [6, 9]. In general, the delay-dependent case is less conservative than delay-independent ones, especially when the delay is comparatively small.

Recently, there have been growing interests in the study of H_∞ control for systems with time delay [8]. Under the assumption that the considered system is regular and impulse free, [10] studied the problem of delay-dependent H_∞ controller design. [11] discussed the delay-dependent robust H_∞ control problem for uncertain singular systems with state delay, and a sufficient condition for designing H_∞ controller was derived in terms of a set of linear matrix inequalities (LMIs). In [12], a new version of delay-dependent bounded real lemmas (BRLs) for singular systems with time delay was established in terms of LMIs, and H_∞ state feedback controller was designed via the obtained LMIs. In fact, the methods given in [11] and [12] can be regarded as the extension of the free weighting matrix approach [13, 14] to singular time-delay systems. It is worth pointing out that the aforementioned results are all relatively complex, since many slack matrix variables are involved.

This paper focuses on the problem of delay-dependent H_∞ control for a class of continuous -time singular linear time-delay systems. Unlike the previous works, the derived H_∞