

IMPROVED DELAY-DEPENDENT ROBUST STABILIZATION OF SINGULAR SYSTEMS

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ABSTRACT. *This paper deals with the class of continuous-time Descriptor Systems with continuous or differentiable uniformly bounded time-varying state delays. An improved delay-dependent stability and stabilization conditions are established without using model transformation and bounding technique for cross terms. Linear matrix inequality (LMI)-based algorithm to design a state feedback control that stabilizes the system is provided for all admissible uncertainties. Numerical examples are solved to show the usefulness and validness of the theoretical results.*

Keywords: Descriptor systems, Time-varying delays, Delay dependent stability, Linear matrix inequality

1. Introduction. Singular systems, which are also known as descriptor systems, semi state-space systems and generalized state-space systems are dynamic systems whose behaviors are described by both differential equations (or difference equations) and algebraic equations. These systems can preserve the structure of practical systems and have extensive applications in power systems, robotic systems and networks [3,9].

Time delay is commonly encountered in various engineering systems, such as manufacturing system, turbojet engine, telecommunication, economic system and chemical engineering system. It is generally regarded as a main source of instability and poor performance. Over the past decades, much attention has been focused on the problems of stability and stabilization analysis for delay systems, [1,2,4-6,8-10,14-19]. The existing results can be classified into two types: delay-independent and delay dependent stability. Generally, the delay-independent case is more conservative than the delay-dependent case, especially when the time delay is comparatively small. The delay-independent and dependent cases for singular systems with constant time-delay have been extensively studied in [15,17] and [1,4-8,14,17-19], respectively. As you see from the tables in the last section the results in [14] are better than the results given in [4-8,17,19]. It was used the augmented system matrices in [14], which makes the solution conservative and the stabilization problem had not been considered in [18]. In both papers, the authors studied the constant delay case. To the best of our knowledge, the class of continuous-time singular systems with time varying delays has not yet been fully investigated.

In this paper, the problem of delay dependent robust stabilization for uncertain singular systems with time-varying state delay is investigated. A delay-dependent sufficient condition for the existence of a state feedback controller guaranteeing that the closed-loop dynamics is regular, impulse free and stable is proposed without using model transformation and any bounding techniques. All results are derived in the LMI framework and the solutions are obtained by using LMI toolbox of Matlab.