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

Dong Yue[1], James Lam[2] and Daniel W.C. Ho[3]

[1]Department of Control Science and Engineering
Nanjing Normal university, Nanjing, Jiangsu 210042, P.R. China
Email: medongy pine.njnu.edu.cn
] [2]Department of Mechanical Engineering
University of Hong Kong, Pokfulam Road, Hong Kong
[3]Department of Mathematics
City University of Hong Kong, Tat Chee Avenue, Hong Kong

Abstract. This paper is concerned with the robust exponential stability of descriptor systems with time-varying delays and time-varying parameter uncertainties. Delay-dependent stability criteria, given in terms of linear matrix inequalities, are proposed, which guarantee the considered system is regular and impluse-free independent of the delay time and robustly exponentially stable when the delay time is sufficiently small. Applications of the derived theorems are given through examples.
Keywords. Descriptor system, stability, time delay, linear matrix inequality, Lyapunov method.

1 Introduction

Notation: $\mathbb{R}^n$ denotes the n-dimensional Euclidean space, $\mathbb{R}^{n\times m}$ is the set of $n \times m$ real matrices, I_n denotes the $n \times n$ identity matrix, $\|\cdot\|$ stands for the Euclidean vector norm or induced matrix 2-norm as appropriate. The notation $X > 0$ (respectively, $X \geq 0$), for $X \in \mathbb{R}^{n\times n}$ means that the matrix X is real symmetric positive definite (respectively, positive semi-definite). The spectral radius of a matrix X is denoted by $\rho(X)$. If not explicitly stated, matrices are assumed to have compatible dimension for algebraic operations.

Many practical processes can be modeled as descriptor systems, such as constrained control problems, electrical circuits, certain population growth models and singular perturbations. Over the past several years, much attention has been paid to the study of descriptor systems [2, 5, 6, 12, 19, 13, 14, 18, 20].

As is well known, in real engineering systems, time delays are often encountered and may be a source of instability of the systems. Consequently, the stability and stabilization problems of time-delay systems have attracted considerable attention, and a number of results have been reported. These results can be classified into two categories, namely, delay-independent results