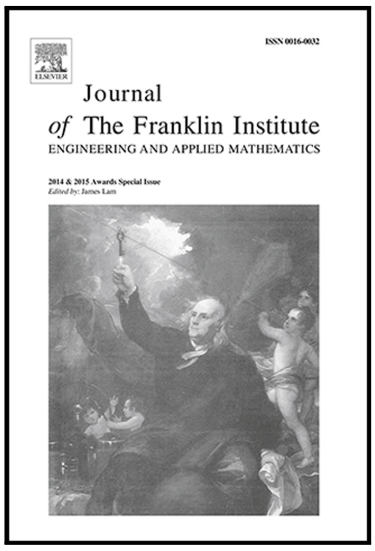

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Finite-time stability of singular nonlinear switched time-delay systems: A singular value decomposition approach

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Abstract

In this paper, a constructive geometric design of switching laws is proposed for the finite-time stability of singular nonlinear switched systems subjected to delay and disturbance. The state-dependent switching law is constructed based on the construction of a partition of the stability state regions in convex cones such that each system mode is activated in one particular conic zone. Using the state-space singular value decomposition approach, new delay-dependent sufficient conditions for the finite-time stability of the system are presented in terms of linear matrix inequalities (LMIs). The obtained results are applied to uncertain linear singular switched systems with delay. Numerical examples are given to illustrate the effectiveness of the proposed method.

Keywords: Finite-time stability, singular systems, switching law, time-delay, linear matrix inequalities.

1. Introduction

Switched systems belong to an important class of hybrid systems arise in many practical processes that cannot be described by exclusively continuous or exclusively discrete models, such as manufacturing, communication networks, automotive engineering control, chemical processes [1, 2]. Many effective methods have been proposed to studying stability and control of switched systems, such as the Lyapunov function approach, the LMI approach, and average dwell-time scheme [3-5]. On the other hand, stability and control problems of singular systems have been extensively studied due to the fact that the singular system better describes physical systems than state-space systems [6-9]. Recently stability and stabilization of singular fuzzy systems [10] have been addressed in [10] by using non-quadratic Lyapunov functions and S-procedure. For switched singular systems without delay, the stability analysis was discussed in [11] by using piecewise Lyapunov function method and switching law satisfying an average dwell-time constraint. For the systems with delay, because of the combination between the switching and the time-delay and due to the algebraic constraints in singular models, the stability analysis of such systems is much more complicated than that of singular systems without delays. Based on the average dwell-time approach, the authors of [12, 13] proposed some sufficient conditions for robust exponential admissibility of singular linear switched systems and the authors of [14] extended the existing results on exponential stability of singular nonlinear switched systems with time-varying delay. It should be noticed that most of the mentioned papers are focused on the asymptotic stability. In many practical applications, the main concern is the behavior of the system over a fixed finite time interval. In these cases,

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