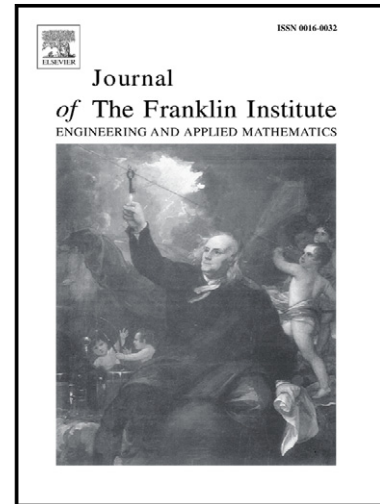


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Synchronous switching observer for nonlinear switched systems with minimum dwell time constraint

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Abstract

This paper deals with the issue of state observability for a class of nonlinear switched systems under minimum dwell time (MDT) switching. First, multiple full-order switched observers are designed to estimate the states of nonlinear switched system under MDT switching, and the observer gains are derived from the feasible solutions of linear matrix inequality. Meanwhile, the condition where the minimum dwell time should satisfy is provided such that the observer error dynamic is exponentially asymptotically stable. Second, under the assumption, the output matrices of nonlinear switched system are with some special forms which can also be dealt by orthogonal procedure if they are not satisfied, multiple reduced-order switched observers are proposed by coordinate transformation approach such that the state estimation purpose is reached for original nonlinear switched systems. Third, the MDT condition that the switching signal should meet with is given such that both full-order and reduced-order switched observers can be simultaneously designed. Finally, the effectiveness of the proposed approaches is illustrated by a numerical example and longitudinal switched dynamics of an F-18 aircraft.

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Keywords:

Nonlinear switched system, Switched observer, Minimum dwell time, Linear matrix inequality

1. Introduction

A switched system is a dynamical system that consists of a finite number of dynamical subsystems described by differential or difference equations and a switching rule, called a switching signal, that determines the switching manner between the subsystems of switched system [1]. Recently, there has been an increasing interest in the state observation for switched systems because of their signification in both theory and applications. Many physical or man-made systems, such as chaos generators [2], DC/DC converters [3], flight control systems and network control systems [4-5], display the switching features. So far, many results on stability analysis and control synthesis for various types of switched systems have been studied due to their numerous applications [6-21]. Among these studies, Lin and Antsaklis survey the research results in the fields of stability analysis and switching stabilization for switched systems [7]. Allerhand and Shaked design a state-dependent switching law that obeys a dwell time constraint and guarantees the stability of a linear switched system, and the sufficient conditions are obtained for the stability of the switched systems [11]. Zhao et al. investigates the problem of switching stabilization for slowly switched linear

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