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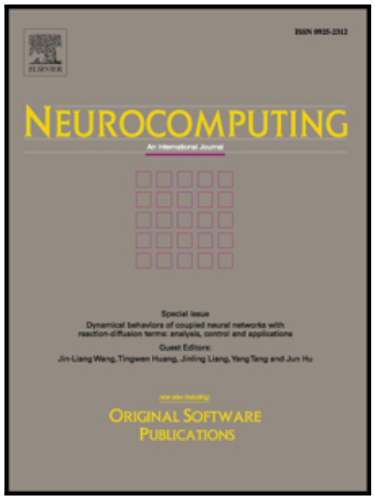

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Network-based fuzzy H_∞ controller design for T-S fuzzy systems via a new event-triggered communication scheme

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Abstract

This paper is concerned with network-based fuzzy H_∞ control for a class of T-S fuzzy systems under an event-triggered communication scheme. Considering the fact that the network-induced delays are inevitable, the closed-loop system is modelled with asynchronous membership functions. To deal with the asynchronous membership functions, a new condition which limits the deviation bounds of membership functions, is introduced into the event-triggered scheme (ET scheme). Besides, by introducing a fuzzy event-triggered weighting matrix, a new ET scheme is proposed. Based on the proposed ET scheme, a novel criterion for the asymptotic stability and H_∞ performance analysis is established in terms of linear matrix inequalities. Then some sufficient conditions and an algorithm to co-design the controller and the parameters of the ET scheme are presented. The effectiveness of the proposed method is illustrated through a mass-spring-damper system.

Keywords: event-triggered scheme; network-based fuzzy H_∞ control; T-S fuzzy system; asynchronous membership functions

1 Introduction

Recently, networked control systems (NCSs) have received considerable attention due to their advantages such as low cost, reduced weight and power requirements, simple installation and maintenances, sharing of the resources, and their wide applications, e.g. remote surgery [2], mobile sensor networks [3] and intelligent transportation systems [4]. NCSs are control systems in which sensors, controllers and actuators are physically distributed at different locations, and data among the different components is transmitted through a shared communication network. Since communication bandwidth in a shared communication channel is a scarce resource, one common problem to be addressed when considering NCSs is whether there is sufficient communication bandwidth to feed back information to the controller, and then send the control commands to the actuators and the plant[5]. Thus, an interesting and important topic is how to reduce the network bandwidth utilization while guaranteeing the stability and the other desired control performance of the NCSs. As is well known, time-triggered scheme is widely used for NCSs, e.g. [6, 8, 9]. However, it may lead to wastage of the limited communication resource for that all the sampled-data are transmitted. In recent years, another communication scheme, called event-triggered scheme (ET scheme), has received much attention, e.g. [10, 11, 12], for its capacity of reducing the data transmission in the NCSs.

In the event-triggered control framework, the requirements of communication are determined by the occurrence of an "event" rather than "time" and it has been proved to be an efficient way to reduce the network bandwidth utilization in comparison with the traditional time-triggered scheme. Meanwhile, while many industrial control, communication and biomedical systems have severe nonlinear characteristics, as we all know, Takagi-Sugeno (T-S) fuzzy modeling [13] is very efficient to describe a wide class of nonlinear systems [14]. Moreover, fuzzy model can also be used to approximate unknown complex dynamics based on adaptive technique, such as [15, 16].

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