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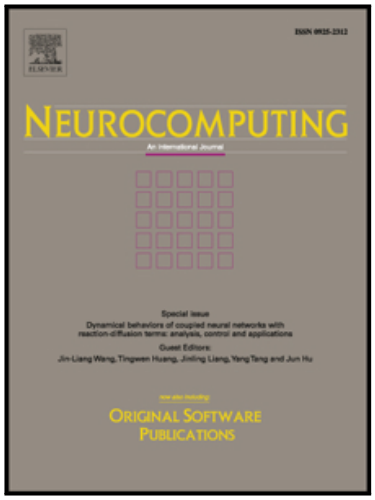

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Admissibility Analysis of Interval Type-2 Uncertain Stochastic Descriptor Systems

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Abstract

This paper considers the admissibility of interval type-2 (IT2) uncertain Itô stochastic descriptor systems. Both membership functions and parametric matrices of considered nonlinear systems contain uncertain parameters. An IT2 fuzzy controller is designed such that the closed-loop descriptor systems is admissible. The membership functions of the controller and systems are unmatched. In the control systems, membership functions are represented by a partition method of footprint of uncertainty (FOU). Some conditions dependent on membership functions for the existence of IT2 fuzzy controller are obtained in the form of linear matrix inequality (LMI). In order to verify the effectiveness and feasibility of the proposed method, an IT2 fuzzy controller is designed for inverted pendulum system.

Keywords: Descriptor systems; Parametric uncertainty; Stochastic system; Interval type-2 fuzzy model.

1. Introduction

Over the past few decades, Takagi-Sugeno (T-S) fuzzy model [1] (also called type-1 fuzzy model), well known for its accuracy to approximate nonlinear systems, has been applied extensively in complex nonlinear systems [2–4]. On the basic of parallel distributed compensation (PDC) concept, considerable significant researches on T-S fuzzy systems have been reported, see [5–11] and references therein. However, the overall fuzzy systems cannot be utilized to capture the uncertain parameters in membership functions. In order to describe the uncertainties effectively, the authors in [12] first developed the Type-2 fuzzy set. On this basis, a large number of researches about type-2 fuzzy systems have been reported. The results in [13–15] shown the better performance of type-2 fuzzy systems than type-1 versions. In addition, considerable attention has been attracted on stability analysis and synthesis of Interval type-2 (IT2) fuzzy system. Some researches about stability analysis of IT2 fuzzy system have been reported in recent years [16–20]. The stability of IT2 fuzzy systems has been studied in [21]. In [22], the authors designed an IT2 fuzzy sliding-mode controller for linear and nonlinear systems.

Descriptor systems (so-called implicit systems, generalised state-space systems or differential-algebraic systems), a major research field of control theory, has also drawn considerable attention in last two decades. Owing that the behaviour of some physical system can be described more general and natural by a descriptor system, therefore, the descriptor systems have been extensively researched in circuits [23], economic [24] and many other fields [25–29] in the last few years. It should be pointed out that the possible impulse behaviour in descriptor system control is

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