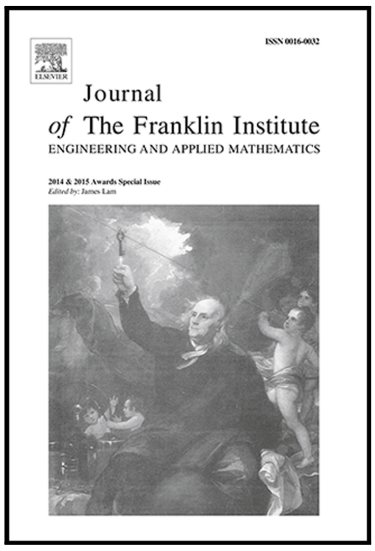

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PII: S0016-0032(17)30338-1
DOI: 10.1016/j.jfranklin.2017.07.024
Reference: FI 3063

To appear in: *Journal of the Franklin Institute*

Received date: 14 February 2017
Revised date: 19 May 2017
Accepted date: 3 July 2017

Please cite this article as: Chao Ge, Hong Wang, Yajuan Liu, Ju H. Park, Improved stabilization criteria for fuzzy systems under variable sampling, *Journal of the Franklin Institute* (2017), doi: 10.1016/j.jfranklin.2017.07.024

Improved stabilization criteria for fuzzy systems under variable sampling

Chao Ge, Hong Wang, Yajuan Liu, Ju H. Park*†

Abstract. This paper investigates the problem of stabilization for fuzzy sampled-data systems with variable sampling. A novel Lyapunov-Krasovskii functional (LKF) is introduced to the fuzzy systems. The benefit of the new approach is that the LKF develops more information about actual sampling pattern of the fuzzy sampled-data systems. In addition, some symmetric matrices involved in the LKF are not required to be positive definite. Based on a recently introduced Wirtinger-based integral inequality that has been shown to be less conservative than Jensen's inequality, much less conservative stabilization conditions are obtained. Then, the corresponding sampled-data controller can be synthesized by solving a set of linear matrix inequalities (LMIs). Finally, an illustrative example is given to show the feasibility and effectiveness of the proposed method.

Keywords: Fuzzy systems, linear matrix inequalities (LMIs), sampled-data control, stability analysis.

1. Introduction

In the past several years, considerable attention has been attracted to Takagi-Sugeno (T-S) fuzzy system [1] from both the academic and industrial communities, and many important results have been reported in this field [2-5]. A nonlinear dynamical system can be denoted as linear models through T-S fuzzy model. By using fuzzy membership functions, the total fuzzy model can be acquired by compounding the linear models. Then, a discrete gain-scheduled state feedback controller is designed for linear model. The total controller is a fuzzy mixture of each local linear controller. To an extent, the T-S fuzzy model method can be used to facilitate the analysis and synthesis a nonlinear dynamic system[6-10].

With the rapid development of digital computing science, the digital devices which have the advantage of low installation cost, better reliability and easy maintenance are gradually utilized in industrial applications. This allows fuzzy system only using the samples of continuous-time measurement signals at discrete time instants. These samples are used to control the continuous-time plant through a zero-order hold (ZOH). The approach drastically increases the efficiency of bandwidth usage and reduces the system information. This control system is considered to be sampled-data system. Because the control signals between any two continuous sampling instants will be held constant and only be changed at each sampling time, the analysis and synthesis of sampled-date systems are difficult and complex. The most popular method which has been widely used to sampled-data system is the input delay method [11-15]. Based on this method, the sampled-data system is described as a continuous-time system with time-varying delay generated by the ZOH. Then, the stability conditions in terms of LMIs will be established by the LKF method. Under constant sampling, in [16], network-based robust passive control for fuzzy systems with randomly occurring uncertainties was investigated and in [17-19], the

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