Relaxed exponential stabilization of T-S fuzzy systems with time delay

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Abstract

This paper investigates the design of a robust fuzzy controller for the T-S (Takagi-Sugeno) fuzzy system with time delay. The idea of composite control that incorporates the parallel distributed compensation (PDC) and supervisory control is introduced. Compared with earlier studies based on the framework of linear matrix inequalities (LMI's), the proposed method can synthesize the fuzzy controller more efficiently and guarantee exponential stability of the control performance. The goal of applying supervisory control is to overcome the coupling effect, which is caused by the fuzzy inferences, and simplify design constraints. With the supervisory control the stability conditions can be significantly relaxed, so the LMI solution is more likely to be obtained than by including the basic stability conditions. In particular, the principle of parametric optimization is adopted to determine the control parameters. It is shown that the dynamics of the fuzzy system actually contain explicit information and can be analyzed in advance to facilitate the design. Finally, numeric examples are given to validate the proposed approach.

Keywords: T-S fuzzy system, Linear matrix inequality, Parallel distributed compensation, Robust stability.

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