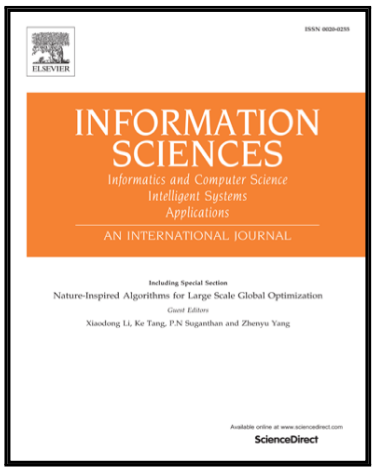

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Reduced-Order Model Approximation of Fuzzy Switched Systems with Pre-specified Performance☆

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Abstract

The reduced-order model approximation problem for discrete-time hybrid switched nonlinear systems is addressed via Takagi-Sugeno (T-S) fuzzy modelling in this paper. For a high-dimension hybrid switched nonlinear system, our aim is on how to construct a reduced-dimension hybrid switched model, approximating its original high-order model well with a pre-specified system performance level. Firstly, the mean-square exponential stability analysis is provided, in which it guarantees the given weighted $\mathscr{H}_\infty$ system performance level for the augmented error dynamic system by the average dwell time analysis approach and the hybrid switched Lyapunov stability theory. The solution of corresponding model reduction problem with pre-specified performance is given by using the projection Lemma, by which the algorithm of the reduced-order hybrid switched model parameters are designed by the cone complementary linearization technique. Finally, the advantage and effectiveness of the proposed reduced-order model approximation approach are shown by the simulation result.

Keywords: Model reduction, model approximation, reduced-order systems, switched systems, hybrid systems

1. Introduction

A finite number of independent control subsystems, including discrete-time or continuous-time dynamics, and a switching signal governing the activation of these concerned subsystems, form hybrid stochastic switched systems, which is a significant component of stochastic jump systems in [25, 26, 27, 28]. A large class of practical systems and processes, including advanced transportation managements systems, automated highway systems, communication systems and network control systems [40, 41], can be characterized as hybrid stochastic switched systems. Moreover, there are some intelligent control strategies with the idea of introducing hybrid switching controllers, which break the limitations of the traditionally adopted single controller effectively and greatly improve the resulted closed-loop control system performance level. By this, the corresponding closed-loop control systems are translated into a typical hybrid stochastic switched systems. Considerable efforts have been put on the hybrid stochastic switched systems

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