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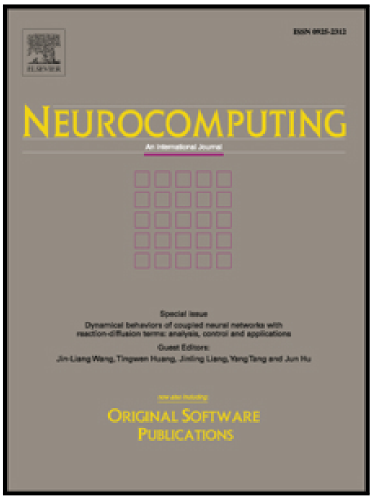

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Rathinasamy Sakthivel, Ramalingam Sakthivel, Boomipalagan Kaviarasan, Faris Alzahrani

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Leader-following exponential consensus of input saturated stochastic multi-agent systems with Markov jump parameters

Rathinasamy Sakthivel[1,2,*], Ramalingam Sakthivel[3], Boomipalagan Kaviarasan[3] and Faris Alzahrani[2]

[1]Department of Mathematics, Bharathiar University, Coimbatore - 641046, India.

[2]Nonlinear Analysis and Applied Mathematics (NAAM) Research Group, Department of Mathematics, Faculty of Science, King Abdulaziz University, Jeddah 21589, Saudi Arabia.

[3]Department of Mathematics, Anna University Regional Campus, Coimbatore - 641046, India.

Abstract

This paper is concerned with the solvability of leader-following exponential consensus of a stochastic nonlinear multi-agent system in the presence of Markov jump parameters and input saturation by using a fault-tolerant control scheme. Firstly, the interconnection topology that represents the communication between the leader and follower agents is chosen to be undirected and fixed. Secondly, to exhibit real scenario, a time-varying actuator fault model is incorporated in the fault-tolerant control design. Thirdly, by introducing a simple linear transformation, an error system is then formulated. Based on these setups and by employing the tools from algebraic graph theory and Lyapunov-Krasovskii stability theory, a distributed robust fault-tolerant controller is designed for each follower node in terms of linear matrix inequalities such that the closed-loop error system is exponentially stable in the sense of mean-square even in the presence of possible actuator faults. Lastly, a simulation study is presented to illustrate the efficacy of the proposed control design technique.

Keywords: Leader-following consensus; Multi-agent systems; Input saturation; Markov jump parameters.

I. Introduction

In recent years, the study of multi-agent systems has been revitalized since these systems are widely applied to many real-life applications, including sensor networks, unmanned aerial vehicles, world wide web, robotics and fish school [1], [2]. It should be noted that multi-agent systems generally consist of many interacting agents in which each agent knows only a part of the overall objective function, partial constraints and local information from its neighbors which can cooperate to solve some complex tasks that are beyond the capabilities of an individual agent. Therefore, the analysis and synthesis of dynamical behaviors of multi-agent systems have recently become very compelling and there has been a wealth of research regarding qualitative analysis of multi-agent systems in the literature. From the control perspective, the investigation of consensus problem of multi-agent systems has been a hot research topic in the recent few years [3], [4], [5]. It is noteworthy that there are two kinds of consensus problems in the literature which are: leaderless consensus [6], [7] and leader-following consensus [8], [9]. Although leaderless consensus is useful in many applications, such as cooperative rendezvous of a group of agents, there are many applications that require a dynamic leader [10]. Moreover, it is worth mentioning that the majority of results about multi-agent systems have assumed that the dynamics of the multi-agent systems are deterministic. However, in practice, the dynamics of multi-agent systems are usually stochastic because randomly

*Corresponding author: E-mail address: krsakthivel@yahoo.com