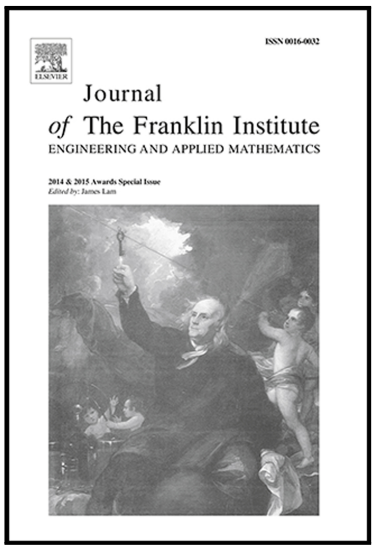

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Adaptive fault-tolerant control for a class of nonlinear multi-agent systems with actuator faults

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Abstract

This paper considers the distributed adaptive fault-tolerant control problem for linear multi-agent systems with matched unknown nonlinear functions and actuator bias faults. By using fuzzy logic systems to approximate the unknown nonlinear function and constructing a local observer to estimate the states, an effective distributed adaptive fault-tolerant controller is developed. Furthermore, different from the traditional method to estimate the weight matrix, only the weight vector needs to be estimated by exchanging the order of weight vectors and fuzzy basis functions in the fuzzy logic systems. In contrast to the existing results, the assumption that the dimensions of input vector and output vector are equal is removed. In addition, it is proved that the proposed control protocol guarantees all signals in the closed-loop systems are bounded and all agents converge to the leader with bounded residual errors. Finally, simulation examples are given to illustrate the effectiveness of the proposed method.

Keywords: Fault-tolerant control, multi-agent systems, actuator bias fault, fuzzy logic systems, nonlinear function

1. Introduction

In recent years, tremendous interest has been drawn to the distributed cooperative control for multi-agent systems (MAS) due to the widespread applications in many fields, such as unmanned air vehicles, mobile robot networks, formation control of multiple robots, etc [1]-[3]. Consensus is one of the interesting issues in cooperative control. The main idea of consensus is to design controllers with their neighbor information such that all agents reach an agreement. Generally, consensus can be broadly classified into leaderless consensus [4]-[5] and leader-following consensus [6]-[8]. The objective of leaderless consensus is to design distributed controllers for the MAS such that all agents converge to a common trajectory. If the trajectory is formed by the leader, this problem can be called the leader-following consensus.

However, many practical systems in engineering are inherently nonlinear. Therefore, the consensus for nonlinear MAS has recently received increasing attentions. In order to deal with the unknown nonlinear functions, the neural network and fuzzy logic systems (FLS) have been used in the cooperative control for MAS a few years ago. The distributed adaptive neural network controllers are proposed in [9] and [10] to obtain the consensus for first-order nonlinear MAS. This result is extended to the consensus for second-order nonlinear MAS [11] and [12]. The robust adaptive neural network controller and fuzzy controller are designed for higher-order nonlinear MAS in [13] and [14], respectively. Although the literatures have made some efforts, they all assume that the state information is measurable. However, in many practical situations, some state variables are not available. Therefore, output feedback controllers

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