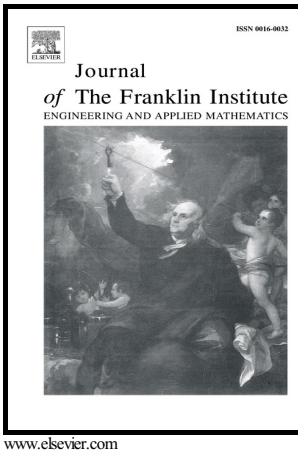

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Distributed adaptive repetitive consensus control framework for uncertain nonlinear leader-follower multi-agent systems

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Abstract

In this paper, we propose an adaptive repetitive control framework for uncertain nonlinear multi-agent systems. Based on the framework, by learning periodic uncertainties, consensus-based learning control protocols are designed for nonlinear multi-agent systems with time-varying parametric uncertainty. The learning-based updating law is utilized to compensate for periodic time-varying parametric uncertainties. With the dynamic of the leader unknown to any follower agents, a new auxiliary control is designed for each follower agent to deal with the leader's dynamic. Then, the proposed learning control protocol guarantees that all follower agents can track the leader. Furthermore, as an extension of the consensus problem, the formation problem is studied. Finally, simulation examples are given to illustrate the effectiveness of the proposed method in this article.

Keywords: Multi-agent systems; Nonlinear systems; Time-varying parametric uncertainties; Repetitive control; Consensus algorithm.

1. Introduction

It is well known that learning control is efficient in dealing with control tasks which are repetitive in nature. Learning control approach mainly makes full use of the information from previous trail or period to improve the control performance of current trial or period, and it can be in general classified into finite interval learning (FIL) and infinite interval learning (IIL). Iterative learning control(ILC) [1,2] is a typical approach of FIL and repetitive type learning control [3] is a typical approach of IIL. In paper [4], the authors illustrated how a learning-based estimate can be used to achieve asymptotic tracking in the presence of a nonlinear disturbance. A new adaptive control approach characterized by periodic parameter adaptation was proposed in [5].

Recently, studies on the distributed cooperative control of multi-agent systems or networks have attracted a lot of attention from various research communities [6-17]. The consensus problem, i.e., every agent asymptotically approaches a common value, has become a focus in the distributed coordination of multi-agent systems. In the past decades, consensus problems for multi-agent systems have been studied by many researchers. Much attention has been paid to consensus of first order [18-21] and second order [22-23] integrator dynamics. There are many studies about the consensus control of multi-agent systems with uncertain dynamics. The paper [24] proposed a robust adaptive control approach for the consensus problem of multi-agent system, where the effects of uncertainties and disturbances were counteracted by employing the adaptive neural network and the robust control technique. A neural-network-based adaptive approach was proposed for the leader-following control of multi-agent systems in [25]. Adaptive synchronization controllers were presented in [26] for distributed systems having non-identical unknown nonlinear dynamics, and the target dynamics to be tracked was also nonlinear and unknown. Then, in the literature [27], the

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