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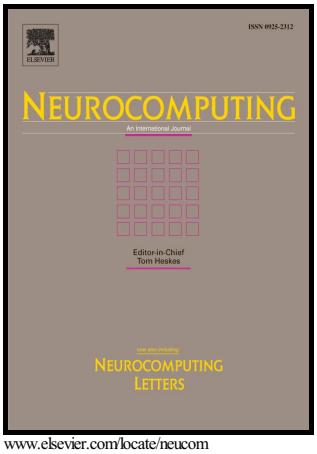

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Neural-network-based distributed adaptive synchronization for nonlinear multi-agent systems in pure-feedback form

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Abstract

In this paper, the problem of distributed adaptive synchronization for unknown nonlinear multi-agent systems in pure-feedback form is studied under a directed graph. Neural networks are used to approximate the unknown nonlinear dynamics, and by incorporating the dynamic surface control (DSC) technique into backstepping design procedure, distributed adaptive consensus controllers are developed. A novel method is given for reducing the burden of networked communication. It is shown that the proposed distributed consensus controllers guarantee that all signals in the closed-loop system are cooperatively semi-globally uniformly ultimately bounded, and the consensus errors converge to a small neighborhood of the origin. Finally, a simulation example is given to show the effectiveness of the designed control scheme.

Keywords: Neural networks, synchronization, nonlinear multi-agents systems, distributed adaptive control.

1 Introduction

Over the past few decades, cooperative control of multi-agent systems has received considerable attention due to its wide applications in practical systems. Consensus algorithms for networks of dynamic agents with switching topologies and time delays was proposed [1]. In [2], output synchronization of networked multi-agent systems was studied, where the dynamics of agents were nonlinear. More effective distributed schemes have been proposed to solve the cooperative control problems of multi-agent systems [3–12]. Nevertheless, the aforementioned works are restricted to multi-agent systems with known dynamics. In practice, the multi-agent dynamics may be unknown, and these control methods can not be applied.

It is well known that neural networks are universal approximators and have good ability to approximate unknown nonlinear functions [13,14]. Many physical systems are inherently both nonlinear and distributed. In recent years, distributed consensus control of nonlinear multi-agent systems with unknown dynamics has become an attractive research topic and lots of eminent results have been reported [15–22]. In [15–20], neural-network-based distributed adaptive approaches were proposed for nonlinear multi-agent systems. However, the agents dynamics are first-order or second-order. By considering many systems with higher-order dynamics, the authors in [21, 22] extended the results in [17] to higher order nonlinear multi-agent systems with nonidentical unknown dynamics. Although these methods can deal with the consensus

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