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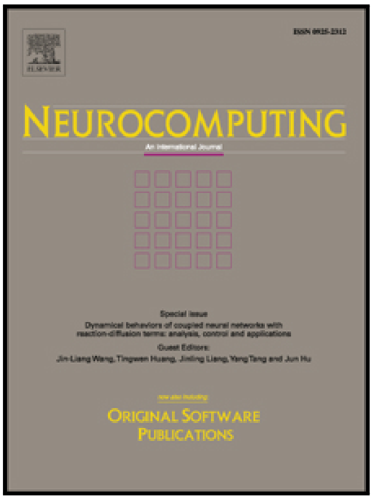

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Consensus of Linear Multi-agent Systems via Adaptive Event-based Protocols ☆

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Abstract

This paper investigates the consensus problem of multi-agent systems (MASs) described by linear dynamic models. In order to avoid using the global information and reduce communication burden, the distributed adaptive event-based control approach is presented. Some novel triggering functions and control protocols are designed. The obtained results show that consensus can be achieved only with local information and communicating with neighbors continually is avoided as well. In addition, the Zeno-behavior for the concerned closed-loop system is excluded. Finally, a numerical example is provided to validate the availability of the obtained theoretical results.

Keywords:
Multi-agent systems, Consensus, Adaptive control, Event-based

1. Introduction

In the past few years, consensus problem of MASs has drawn wide attention in the field of control [1–3]. In order to ensure consensus of MASs, the global information, such as the eigenvalues of the corresponding Laplacian matrix, is usually required to determine the control gains or parameters of triggering functions [4–6]. It should be noted that requiring global information is extremely strict and hard to satisfy especially for MASs with a large amounts of agents.

To cope with aforementioned problem, adaptive control protocols [7–9] were proposed for distributed consensus of MASs, which only local information was used. In [10], a distributed adaptive controller was given to consider the cooperative output regulation problem for MASs described by heterogeneous linear agent dynamic. And the exogenous signal was estimated by the distributed adaptive observer. In [11], by assigning a time-varying coupling weight to each node, adaptive protocols were designed to solve the containment problem of heterogeneous linear MASs. In [12], a novel adaptive control strategy was developed to study the leader-follower consensus problem for linear MASs with external disturbances. However, the continuous information between neighbors is needed in the adaptive protocols [7–12], which may lead to the waste of communication resources.

In order to save communication resources and reduce communication burden, event-based control protocols have been proposed for the consensus of MASs in recent years. Event-based implementation of consensus protocols was firstly developed in [13]. Since then, there have appeared many studies on event-based consensus of various MASs, such as, first-order MASs [14–18], second-order MASs [4, 19–22], linear MASs [5, 6, 23–28], and many references therein. However, the control protocols in [4–6, 19–25, 27, 28] were not fully distributed since the determination of parameters of triggering functions or the control protocols needed the global information, such as the eigenvalues of the corresponding Laplacian matrix.

More recently, by combining adaptive control strategy and event-based control strategy, distributed adaptive event-based control was developed for consensus of MASs [29–31], which showed that consensus of MASs can be achieved only with local information and the consumption of communication resources can be reduced as well. In [29], a fully distributed consensus protocol was developed, which was independent of any global information of the network graph. In [30], a distributed adaptive protocol was introduced to achieve the leader-following consensus for Lipschitz nonlinear MASs. In [31], a novel adaptive event-based controller and triggering function were designed to reach consensus of MASs with general linear dynamics.

Motivated by the above discussion, fully distributed adaptive event-based consensus of linear MASs is studied in this paper. The contributions contain:

(I) Distributed adaptive event-based control protocols are designed without using any global information. Hence, the proposed protocols are fully distributed.

(II) The obtained result shows that continuous communication between neighboring agents can be avoided, where agents

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