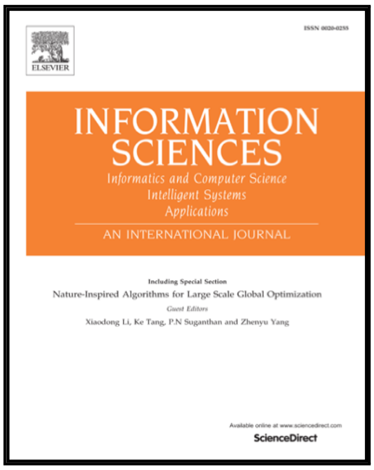

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Lei Shi, Jinliang Shao, Mengtao Cao, Hong Xia

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Asynchronous group consensus for discrete-time heterogeneous multi-agent systems under dynamically changing interaction topologies☆

Lei Shi[a], Jinliang Shao[a,*], Mengtao Cao[b], Hong Xia[b]

[a]*School of Automation Engineering, University of Electronic Science and Technology of China, Sichuan, 611731, PR China*
[b]*School of Mathematical Sciences, University of Electronic Science and Technology of China, Sichuan, 611731, PR China*

Abstract

This paper aims to investigate the asynchronous group consensus problem for discrete-time heterogeneous multi-agent systems under dynamically changing interaction topologies. Here the heterogeneous system is composed of hybrid dynamic agents including first-order dynamic agents and second-order dynamic agents, and asynchrony implies that each agent only detects the neighbors' state information at certain discrete time instants determined by its own clock that is independent of the other agents'. For different kinds of agents, two asynchronous consensus protocols are proposed to realize local control strategies, respectively. With the help of nonnegative matrix theory, in particular the product properties of row-stochastic matrices from a noncompact set, a sufficient condition in terms of the interaction topologies is established to guarantee that the asynchronous group consensus problem can be solved under very relaxed conditions, i.e., the union of the effective interaction topologies across any time intervals with some given length is only required to contain a spanning tree. Numerical examples are finally provided to validate the theoretical results.

Keywords: Asynchronous; Group consensus; Heterogeneous multi-agent systems.

1. Introduction

Consensus of multiple agents, as an important and fundamental topic of distributed cooperative control, has drawn increasing interests among many researchers in different fields over the past few decades. This is partly due to its various applications in real world, including unmanned air vehicle formation [1, 38], rendezvous [5], formation control [14] and flocking [18]. Consensus refers that a team of agents with different state information eventually reach the same state by implementing appropriate distributed strategies based on the state information with local neighbors. In the early study stage of multi-agent systems, numerous interesting results for consensus problem with first-order dynamics have been reported in the literatures [13, 15, 19, 20, 23, 26, 27]. Because of both position and velocity need to be considered in the movement of many reality systems, the consensus problem for a team of agents guided by second-order dynamics under different circumstances has received great attention recently, see, e.g., [2, 3, 6, 7, 9, 10, 12, 25, 32, 33, 36, 41]. The above

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*Corresponding author

Email addresses: shilei910918@126.com (Lei Shi), jinliangshao@126.com (Jinliang Shao), mtcao@pku.edu.cn (Mengtao Cao), yuxia1126@163.com (Hong Xia)