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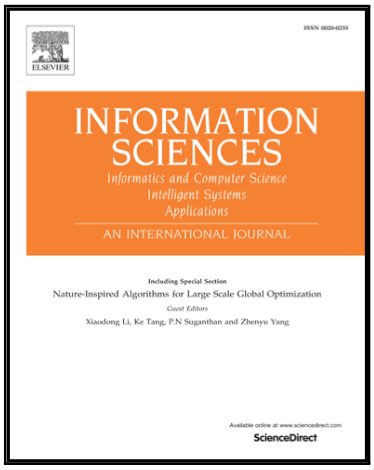

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Huaqing Li , Guo Chen , Zhaoyang Dong , Dawen Xia

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Consensus Analysis of Multiagent Systems with Second-Order Nonlinear Dynamics and General Directed Topology: An Event-Triggered Scheme

Huaqing Li[1, 2], Guo Chen[2, 3,*], Zhaoyang Dong[2], Dawen Xia[4]

1. College of Electronic and Information Engineering, Southwest University, Chongqing 400715, PR China

2. School of Electrical and Information Engineering, The University of Sydney, Sydney 2006, Australia

3.School of Electrical Engineering and Computer Science, The University of Newcastle, Newcastle, Australia

4. School of Information Engineering, Guizhou Minzu University, Guiyang 550025, PR China

*Corresponding author: guochen@ieee.org (G. Chen)

Abstract:

Event-triggered sampling control is motivated by the application of embedded microprocessors equipped in the agents with limited computation and storage resources. This paper studies the global consensus in second-order multi-agent systems with the inherent nonlinear dynamics on general directed networks using decentralized event-triggered strategy. For each agent, only utilizing local and current sampling data, the update of controllers is event-based and only triggered at their own event times. A high-performance sampling event that only needs neighbors' states at their own discrete time instants is presented. Furthermore, we introduce two kinds of general algebraic connectivity for strongly connected networks and strongly connected components of directed networks containing a spanning tree to describe the system's ability to reach consensus. A detailed theoretical analysis on consensus is performed and two criteria are derived by the virtues of algebraic graph theory, matrix theory, and Lyapunov control approach. It is shown that the continuous communication between neighboring agents can be avoided and the Zeno-behavior of triggered time sequence is excluded during the system's whole working process. In addition, numerical simulation is given to illustrate the effectiveness of the theoretical results.

Keywords: Event-triggered control, Multiagent systems, Consensus, Nonlinear dynamics, General topology.

1. Introduction

Over the past few years, the distributed control of multi-agent systems has attracted great attention from various scientific communities, due to its higher robustness, less communication cost, greater efficiency, and so on. Multi-agent systems can be found in many application areas, such as swarming and flocking [29], [38], biological systems [35], physics, teaming of multi-robotics [33], [34], and control engineering [5], [13], [20]-[26], [30], [42], [48]-[50]. One interesting and important issue arising from the distributed control of multi-agent systems is to design distributed protocols based only on the local and relative information so that the states of all agents reaching an agreement can be guaranteed. This is known as the distributed consensus problem. Consensus with a long history in computer science [5], especially in the field of distributed computing, is widely encountered in real-world application and serves as a foundation for the study of collective behavior of multi-agent systems. The graph model is naturally applied, in which each agent is expressed as a vertex, and each communication as an edge between the corresponding agents (vertices).

The consensus problem for agents with the first-order dynamics has recently been investigated from various perspectives [33], [34]. Olfati-Saber et al. [30] presented a systematic framework to analyze the first-order consensus algorithms, and showed that the consensus problem can be solved if a diagraph is strongly connected. Ren et al. [34] further proved that the first-order consensus can be achieved if the union of the dynamically changing interaction graphs has a