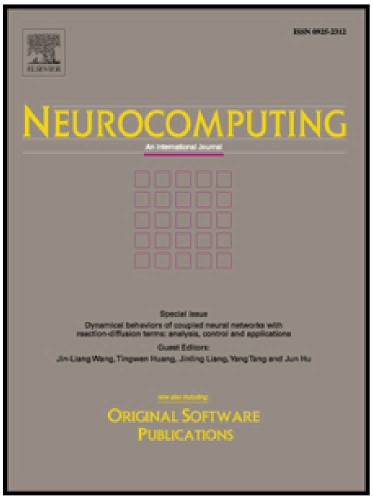
Communicated by Rongni Yang

Accepted Manuscript



Robust consensus of fractional-order multi-agent systems with input saturation and external disturbances

Lin Chen, Yan-Wu Wang, Wu Yang, Jiang-Wen Xiao

PII: S0925-2312(18)30410-7
DOI: 10.1016/j.neucom.2018.04.002
Reference: NEUCOM 19444

To appear in: *Neurocomputing*

Received date: 5 July 2017
Revised date: 10 January 2018
Accepted date: 1 April 2018

Please cite this article as: Lin Chen, Yan-Wu Wang, Wu Yang, Jiang-Wen Xiao, Robust consensus of fractional-order multi-agent systems with input saturation and external disturbances, *Neurocomputing* (2018), doi: 10.1016/j.neucom.2018.04.002

Robust consensus of fractional-order multi-agent systems with input saturation and external disturbances

Lin Chen[a,b], Yan-Wu Wang[a,b,c,*], Wu Yang[a,b], Jiang-Wen Xiao[a,b]

[a]*School of Automation, Huazhong University of Science and Technology, Wuhan, 430074, China*
[b]*Key Laboratory of Image Processing and Intelligent Control(Huazhong University of Science and Technology), Ministry of Education*
[c]*Hubei Provincial Collaborative Innovation Center for New Energy Microgrid, China Three Gorges University*

Abstract

In this paper, the robust consensus problem of fractional-order multi-agent systems with input saturation and external disturbances is studied under a directed fixed topology. It's the first time to consider the fractional-order agent subject to input saturation. When there exist input saturation and external disturbances simultaneously, by means of the Mittag-Leffler stability theorem and low gain feedback technique, a control protocol is presented to guarantee the robust consensus can be achieved. Moreover, as a special case, the leader-following consensus can be achieved when there only exists input saturation. Finally, the results are verified by several simulation examples.

Keywords: Robust consensus, Fractional-order, Input saturation, External disturbances

1. Introduction

Recently, distributed cooperative control of multi-agent systems has drawn increasing attention because of its broad application in numerous fields, such as UAVs, multi-robot cooperation and smart grids [1, 2, 3]. Multi-agent systems with distributed cooperative control can achieve multiple collective behavior, according to the control objectives, which includes consensus [4, 5, 6, 7, 8, 9, 10, 11], formation control [12, 13], synchronization [14, 15, 16], and flocking [17, 18]. As consensus is the fundamental issue in cooperative control, it has been one of the most hot topic of cooperative control. In consensus control, each agent updates its state by interacting with its local neighbor agents to make all the agents arrive at the common state. The existing study on consensus primarily focuses on the integer-order systems, the dynamics of which are first-order, second-order even high-order differential equation.

At present, it has been shown that lots of natural phenomena can not be effectively interpreted by using the integer-order kinetics, such as food searching of germs, chemotaxis behaviour and the group movement of bacteria in lubrications secreted by themselves [19, 20]. Besides, many practical systems cannot be described by integer-order systems when the agent works on some complicated environments[21, 22, 23, 24], for example, aerial vehicles operating under the environment affected by the weather, automobiles running on the road-surface containing viscoelastic materials, and UAVs flying under a complicated environment with lots of particles. In virtue of their hereditary and memory property, fractional-order systems can describe the cases like the above more accurately. Therefore, more and more researches attach great importance to the distributed cooperative control of fractional-order multi-agent systems. Cao et al. [25] firstly investigated the distributed cooperation of fractional-order systems, where the cooperation algorithms was achieved by putting forward several sufficiency conditions. Gong [4] considered the nonlinear fractional-order multi-agent systems, leaderless and leader-follower consensus of which was achieved by using adaptive algorithm. Chen et.al [6] investigated the uncertain fractional-order multi-agent systems, containment consensus of which was achieved by using the analysis of stability and the theory of matrixes. Yang et.al [8] focused on the time-delayed fractional-order multi-agent systems, containment consensus of which was achieved by using frequency domain theorem and Laplace transform. Wang and Yang [26] considered the nonlinear fractional-order multi-agent

*Corresponding author
Email address: wangyw@mail.hust.edu.cn (Yan-Wu Wang)