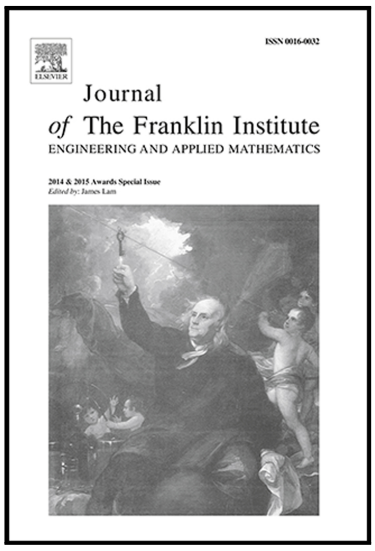

Group Controllability of Two-Time-Scale Multi-Agent Networks

Mingkang Long, Housheng Su, Bo Liu

PII: S0016-0032(18)30393-4
DOI: 10.1016/j.jfranklin.2018.06.006
Reference: FI 3500

To appear in: *Journal of the Franklin Institute*

Received date: 15 November 2017
Revised date: 19 March 2018
Accepted date: 3 June 2018

Please cite this article as: Mingkang Long, Housheng Su, Bo Liu, Group Controllability of Two-Time-Scale Multi-Agent Networks, *Journal of the Franklin Institute* (2018), doi: 10.1016/j.jfranklin.2018.06.006

Group Controllability of Two-Time-Scale Multi-Agent Networks

Mingkang Long[a,b], Housheng Su[b,*], Bo Liu[c]

[a] *School of Science, Hunan University of Technology, Zhuzhou 412008, China*
[b] *School of Automation, Image Processing and Intelligent Control Key Laboratory of Education Ministry of China, Huazhong University of Science and Technology, Luoyu Road 1037, Wuhan 430074, China*
[c] *College of Science, North China University of Technology, Beijing 100144, PR China*

Abstract

As a basic concept in modern control theory, controllability reveals the fundamental structural characteristics of a dynamic system, and it also plays an important part in the analysis and control of a dynamic system. With the increasing complexity of multi-agent systems, the multi-agent networks can be divided into some subnetworks in terms of time scales. This paper concentrates on the group controllability of two-time-scale multi-agent networks, establishes the necessary and sufficient criterion of group controllability based on singular perturbation methods, and deduces easy-to-use group controllability criteria by using matrix theory and graph theory. Lastly, a simulation example is presented to illustrate the effectiveness of the proposed methods.

Keywords: Group controllability, Two-time-scale, Multi-agent networks, Coordination control, Singularly perturbed systems

1. Introduction

With the progress of science and technology, the research of multi-agent systems in control field has attracted many interests and concerns in various areas such as engineering, ecology, biology, sociology and computing science [1]-[13]. The investigations of multi-agent systems have reasonably explained some complicated phenomena of nature and human society, like ant colonies, bird flocks, fish schools [14]-[15] and the dynamic evolution of social public opinion [16]. Moreover, some studies about coordination control of multi-agent systems have been widely applied in many engineering projects, such as multi-robot collaborative working [17], formation control of multiple UAVs [18] and distributed control of smart grids [19].

*Corresponding author
Email address: houshengsu@gmail.com (Housheng Su)