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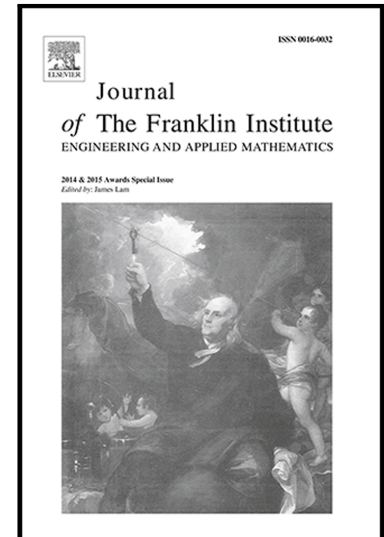
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Group Controllability of Two-Time-Scale Multi-Agent Networks

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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].

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