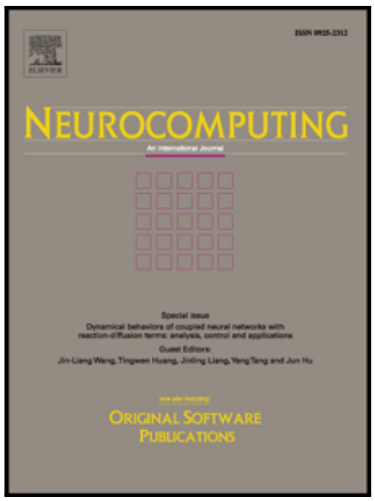

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Lei Shi, Jinliang Shao, Mengtao Cao, Hong Xia

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Distributed containment of heterogeneous multi-agent systems with switching 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, Chengdu 611731, PR China*

[b]*School of Mathematical Sciences, University of Electronic Science and Technology of China, Chengdu 611731, PR China*

Abstract

In this article, we investigate the issue of containment control for a heterogeneous multi-agent system composed of stationary leaders, first-order dynamic followers and second-order dynamic followers under switching communication topologies. For the followers with different order dynamic behavior, two distributed dynamic state feedback algorithms are constructed separately for the followers driven by different dynamics. To achieve the objective of this work, we convert the heterogeneous containment control problem into a convergence problem, which is the product of time-varying non-negative matrices whose sum of each row is less than or equal to 1. With the aid of the matrix product technique and the composite binary relation, a sufficient condition can be established to analyze the convergence problem. At last, some numerical examples are presented to verify the feasibility of the theoretical findings.

Keywords: Distributed containment; Heterogeneous multi-agent systems; Switching topologies.

1. Introduction

The studies on the issue of consensus/synchronization, with the aim to drive a team of units to realize a common goal by communicating with the neighbors, have received increasing research interests over the past few decades because of its wide range of applications in neural network [1–3], sensor network [4–6] and networked multi-agent systems [7–16], etc. Containment control can often be considered as a subclass of multi-agent consensus, in which a small part of the agents are assumed to be the leaders and other agents are naturally called the followers. The research of containment control issue, with the objective to guide the followers into a convex hull structured by the leaders based on a rationally designed protocol, is motivated by numerous natural phenomena. For example, the female moths intermittently release pheromone called bombykol in order to attract male moths, so that male moths often accumulate in the strict geometry of female moths [17].

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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)