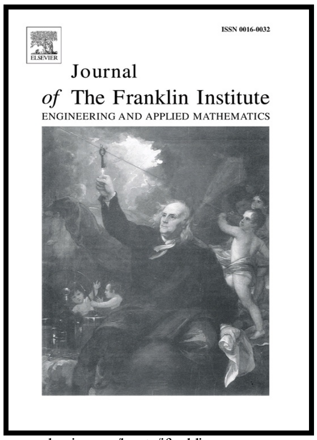
Author’s Accepted Manuscript



www.elsevier.com/locate/jfranklin

Discrete-Time Consensus Strategy for a Class of High-Order Linear Multiagent Systems Under Stochastic Communication Topologies

Hamed Rezaee, Farzaneh Abdollahi

PII: S0016-0032(16)30374-X
DOI: http://dx.doi.org/10.1016/j.jfranklin.2016.10.014
Reference: FI2757

To appear in: *Journal of the Franklin Institute*

Received date: 30 January 2016
Revised date: 21 September 2016
Accepted date: 9 October 2016

Discrete-Time Consensus Strategy for a Class of High-Order Linear Multiagent Systems Under Stochastic Communication Topologies

Hamed Rezaee[a] and Farzaneh Abdollahi[a,b,*]

[a]The Center of Excellence on Control and Robotics, Department of Electrical Engineering
Amirkabir University of Technology (Tehran Polytechnic), Tehran 15914, Iran

[b]Department of Electrical and Computer Engineering
Concordia University, Montreal, Quebec, H3G 1M8, Canada

Abstract

Achieving consensus in a class of high-order discrete-time multiagent systems is studied. It is supposed that the network topology is dynamic and the existence of a communication link between each two agents is stochastic. Based on the concept of discrete-time super-martingales, we propose a Lyapunov-based high-order protocol which guarantees achieving almost sure consensus in the network in the presence of some conditions. The main contribution of the paper compared with existing results for consensus control of high-order multiagent systems under stochastic networks is that the proposed consensus protocol in this paper requires no knowledge on the set of feasible topologies (topologies with nonzero probabilities), and can be designed without computing the eigenvalues of the coupling matrices associated with the feasible topologies. In this condition, the computational costs of the consensus protocol design will be decreased significantly. The results are validated via a numerical example.

Keywords: Almost sure consensus, high-order, discrete-time, multiagent systems, stochastic topology.

1. Introduction

The consensus problem in decentralized networks of dynamic agents has received a compelling attention in various engineering communities over the last decade. This attention is motivated by its wide range of applications from formation and flocking control in multivehicle systems [1, 2, 3] to data fusion in sensory networks [4, 5]. The main objective in this area of research is to derive interaction protocols under which agents achieve identical quantities for some states by using local information.

Early studies on the consensus problem have mainly focused on multiagent systems (MASs) with first-order kinematics [6, 7, 8]. In those approaches, it was supposed that the agents velocities can be determined as control commands. However, in practice, a broad class of systems and vehicles cannot be expressed exactly by first-order kinematics. For instance, when agents control

*Corresponding author, Tel.: +98-21-64543358, Fax: +98-21-66406469, Email: f_abdollahi@aut.ac.ir.