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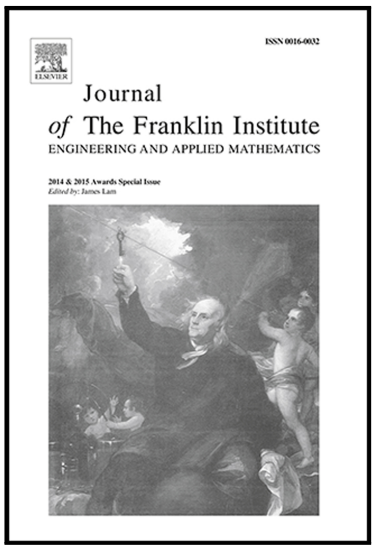

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Dissipative Consensus Problems for Multi-Agent Networks via Sliding Mode Control *

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Abstract

In this paper, dissipative consensus problems are discussed for multi-agent networks. Firstly, sufficient conditions are proposed to ensure $(Q, S, R)-$dissipative consensus for multi-agent networks with external disturbances. Then, by designing an integral-type sliding surface function, a controller is obtained and the corresponding sufficient conditions are given to guarantee $(Q, S, R)-$dissipative consensus for multi-agent networks with external disturbances. Moreover, the sliding mode control law is formulated such that multi-agent networks drive onto the predefined surface in finite time. Finally, an example is given to illustrate the effectiveness of the obtained results.

Keywords: Consensus, $(Q, S, R)-$Dissipativity, Sliding Mode Control, Multi-agent Networks.

1 Introduction

Consensus problems have received significant attention of researchers from different fields such as mathematics, physics, biology, engineering [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12] and have great applications: formation control of mobile robots [9], sensor networks [8] and flocking behavior of birds and herds [1], motions of self-propelled particles [4]. In these literatures, researchers consider the relationships between consensus state, consensus performance, network topologies, and external surroundings. However, in the process of consensus, relative potential energy is dissipative. Consensus problems on energy dissipativity is still an open question.

Dissipativity theory as an effective tool has been used to investigate some problems for networks [13], [14], [15], [16], [17], [18]. In [13] and [14], criteria for H_∞ performance, L_2-L_∞, passivity, and (Q, S, R)-α-dissipativity of filters have been investigated for neural networks. In [15] and [16], dissipative problems of discrete-time neural networks have been studied. Extended dissipativity and stability conditions are obtained for time-varying delay networks and Markov jump networks. In [17], output synchronization problems have been investigated for switched networks with dissipative dynamical nodes. In [19], sufficient conditions are established such that estimation error systems achieve strict $(Q, S, R)-$dissipativity. Decentralized event-triggered dissipative control is investigated in [18]. A sufficient condition is derived such that closed-loop systems are asymptotically stable and strictly $(Q, S, R)-$dissipative.

In reality, agents get energy from their equipments or generate energy through the devices from solar energy, wind power, etc. Energy consumption or dissipation problems play an important role for multi-agent networks in many fields such as robotics and space [2], [3], [17], [20], [10], [11], [12]. Dissipativity theory has been utilized to analyze the robust stability of multi-agent networks. In [10], initial H_∞ consensus filtering is developed by using dissipativity theory of distributed systems. Different from [20], which relies

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