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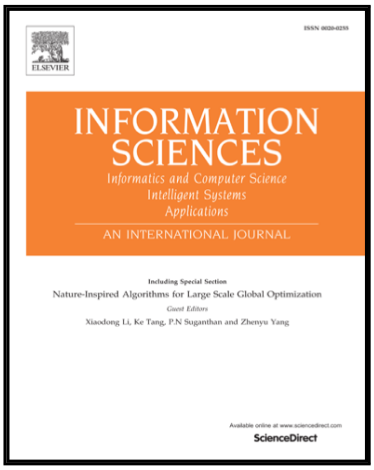

Adaptive fixed-time bipartite tracking consensus control for unknown nonlinear multi-agent systems: An information classification mechanism

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Adaptive fixed-time bipartite tracking consensus control for unknown nonlinear multi-agent systems: An information classification mechanism ☆

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Abstract

This paper is concerned with the problem of bipartite tracking consensus for high-order unknown nonlinear multi-agent systems with actuator faults. Unlike the traditional condition that the directed signed graph is structurally balanced, a directed signed graph containing a spanning tree is considered. Besides, the consensus errors are required to satisfy both the prescribed performance and fast convergence (fixed-time). By proposing an information classification mechanism, each agent selectively uses neighbor information such that agents in the system are divided into two styles, which transform the bipartite tracking consensus problem into a general tracking consensus problem. By using neural networks and adaptive technologies to approximate unknown functions, the adaptive fault-tolerant fixed-time consensus controllers are developed. All signals in the system are bounded within a fixed time. Moreover, the bipartite consensus errors satisfy the prescribed performance by selecting appropriately predefined performance functions. Stability analysis and simulation results further verify the effectiveness of the proposed method.

Keywords: Nonlinear multi-agent systems; bipartite consensus; adaptive control; fault-tolerant control; prescribed performance.

1. Introduction

During the past two decades, cooperative control has attracted increasing attention in multi-agent systems (MAS) [6, 8, 11, 14, 20, 23, 24]. As an important and fundamental issue in cooperative control, consensus problem has been widely studied [2, 9, 17, 28, 42], and numerous achievements over nonnegative graphs have been obtained [7, 15, 25, 35]. A nonnegative graph, whose edges have nonnegative weights, means that only collaboration between agents is considered. However, in practice, antagonistic interactions among neighbors indeed exist, such as social networks [1], multi-robot pursuit-evasion [3], and competition robotic soccer [10]. In such cases, the communication topology can be represented by a signed graph, where positive or negative edges represent cooperation or competition among neighbors, respectively.

Recently, bipartite consensus problems over signed graphs have been investigated [1, 12, 33, 43]. The so called bipartite consensus is that the consensus value is the same in modulus but not in sign. In [1], it is found that the agents could achieve bipartite consensus by using distributed Laplacian-like schemes when the signed graph of the network is structurally balanced. Moreover, under undirected signed graphs, the bipartite tracking problem for second-order linear systems with unknown time-varying disturbances is solved [12] using an adaptive scheme. For directed signed graphs, the related tracking consensus scheme is proposed in [33], where the leader's control inputs are allowed to be unknown for each follower. In [43], the bipartite consensus problem is investigated via state and output feedback control, in which an equivalent relation between bipartite consensus problems and traditional consensus problems is established. However, it should be pointed out that the above methods are Laplacian-like schemes and require the signed graph to

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