Distributed Constrained Consensus of Multi-Agent Systems with Uncertainties and Disturbances under Switching Directed Graphs

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Abstract

This paper provides a distributed leaderless consensus control framework for first- and second-order nonlinear multi-agent systems with time-varying asymmetric state constraints, uncertainties, and disturbances under switching directed graphs. In such framework, original constrained states of agents are first transformed into free states in a transformed state space. To deal with directed graphs, we drive agents towards consensus in the transformed space by leveraging a model reference control scheme, and it is sufficient that the original states reach consensus strictly subject to the time-varying constraints under mild assumptions. A single-layer neural network with weights adapted online is used to approximate the uncertainties in agent dynamics. For the external disturbances and reconstruction errors in the approximation, we introduce a robust term with an adaptive gain for compensation. Distributed consensus algorithms are proposed, respectively, for multi-agent systems with first- or second-order dynamics. We prove convergence to consensus via Lyapunov analysis and perform numerical simulations to validate the effectiveness of the proposed algorithms.

Index Terms

Multi-agent systems, leaderless consensus, state constraints, switching directed graphs, distributed control.

This research was supported in part by the National Natural Science Foundation of China (62073098, U1913209) and the Shenzhen Basic Research Program(JCYJ20200109113210134).

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