Suboptimal Leader-to-Coordination Control for Nonlinear Systems with Switching Topologies: A Learning-Based Method

Shengbo Wang, Shiping Wen, Yin Yang, Kaibo Shi and Tingwen Huang

Abstract: In the cooperative control for multiagent systems (MASs), the key issues of distributed interaction, nonlinear characteristics, and optimization should be considered simultaneously, which, however, remain intractable theoretically even to this day. Considering these factors, this article investigates leader-to-formation control and optimization for nonlinear MASs using a learning-based method. Under time-varying switching topology, a fully distributed state observer based on neural networks is designed to reconstruct the dynamics and the state trajectory of the leader signal with arbitrary precision under jointly connected topology assumption. Benefitted from the observers, formation for MASs under switching topologies is transformed into tracking control for each subsystem with continuous state generated by the observers. An augmented system with discounted infinite LQR performance index is considered to optimize the control effect. Due to the complexity of solving the Hamilton-Jacobi-Bellman equation, the optimal value function is approximated by a critic network via the integral reinforcement learning method without the knowledge of drift dynamics. Meanwhile, an actor network is also presented to assure stability. The tracking errors and estimation weighted matrices are proven to be uniformly ultimately bounded. Finally, two illustrative examples are given to show the effectiveness of this method.

Shiping Wen is the Director of the Intelligent Computing and Systems (ICS) Lab, Australian Artificial Intelligence Institute (AAII).

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