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Distributed consensus control for multi-agent systems using terminal sliding mode and Chebyshev neural networks. (English) [Zbl 1273.93015]

Summary: This paper investigates the problem of consensus tracking control for second-order multi-agent systems in the presence of uncertain dynamics and bounded external disturbances. The communication flow among neighbor agents is described by an undirected connected graph. A fast terminal sliding manifold based on lumped state errors that include absolute and relative state errors is proposed, and then a distributed finite-time consensus tracking controller is developed by using terminal sliding mode and Chebyshev neural networks. In the proposed control scheme, Chebyshev neural networks are used as universal approximators to learn unknown nonlinear functions in the agent dynamics online, and a robust control term using the hyperbolic tangent function is applied to counteract neural-network approximation errors and external disturbances, which makes the proposed controller be continuous and hence chattering-free. Meanwhile, a smooth projection algorithm is employed to guarantee that estimated parameters remain within some known bounded sets. Furthermore, the proposed control scheme for each agent only employs the information of its neighbor agents and guarantees a group of agents to track a time-varying reference trajectory even when the reference signals are available to only a subset of the group members. Most importantly, finite-time stability in both the reaching phase and the sliding phase is guaranteed by a Lyapunov-based approach. Finally, numerical simulations are presented to demonstrate the performance of the proposed controller and show that the proposed controller exceeds a linear hyperplane-based sliding mode controller.

MSC:
93A14 Decentralized systems
68T42 Agent technology and artificial intelligence
93B12 Variable structure systems
93C40 Adaptive control/observation systems

Keywords:
multi-agent systems; consensus tracking; adaptive control; terminal sliding mode; Chebyshev neural network

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References:

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