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Ultra-fast consensus of discrete-time multi-agent systems under a unified framework.

Summary: This paper deals with the ultra-fast consensus problem of high-order discrete-time multi-agent systems under a unified framework. A multi-step neighbor-error predictive mechanism is established based on the future evolution of the network dynamic without predictive information. By predicting the dynamics of a network several steps ahead and adding this information into the consensus protocol, a novel ultra-fast consensus protocol with the self-feedback term is proposed. The asymptotic convergence factor is improved by a power of $q + 1$ compared to the routine consensus protocol. The ultra-fast consensus algorithm can overcome the influence of communication topology to the convergence speed toward consensus, and solve the difficult problem of selecting the optimal control gain which minimizes the asymptotic convergence factor. Moreover, some sufficient conditions for ultra-fast consensus design are given herein. The ones decouple the design of the synchronizing gains from the detailed graph properties, and explicitly reveal how the agent dynamic and the communication graph jointly affect ultra-fast consensus of discrete-time multi-agent systems. A simulation is performed to illustrate the effectiveness of the theoretical results.

Keywords: discrete-time multi-agent system; asymptotic convergence factor; unified consensus framework; self-feedback; distributed control; neighbor-error predictive mechanism
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