Asymptotical outer synchronization control for the complex dynamical networks with unknown bounded interaction via links dynamics

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Abstract

The nodes and their connection relationships (CRs) are the two main parts for a complex dynamical network (CDN). In existing theoretical studies about the outer synchronization, the nodes are considered as the main part of synchronization phenomena mainly associated by coupling effect of CRs between nodes. However, if the CRs between nodes are time-varying, they can also be regarded as one dynamic system coupled with the nodes, and thus their state may evolve with time and maybe assist the nodes to achieve the outer synchronization. From the angle of large-scale systems, a CDN can be regarded as two interconnected subsystems, one of which is the node subsystem (NS) and the other is the link subsystem (LS). Hence, how the whole dynamic of LS contributes to the outer synchronization of NS is one of worthy research problem. In this paper, the two CDNs are considered with the unknown interaction. In each CDN, the dynamics of NS is modelled as the vector differential equation, the LS is modelled as the Riccati matrix differential equation, and the two kinds of differential equations are coupled with each other. By employing the above dynamic models of CDNs and the synthesized coupling terms in the two LSs, the adaptive controller of NS is synthesized for the response CDN. The results show that the outer synchronization happens when the two LSs tracking the synthesized auxiliary dynamic tracking targets. Finally, the numerical simulation is given to show the effectiveness of the theoretical results in this paper.

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