The synchronization of general complex dynamical network via pinning control

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Abstract In this paper, the globally synchronization of the general complex network is investigated. Firstly, we discuss the synchronization problem of the linearly coupled and directed network under the pinning control, and make comparison with the previous work about the undirected network. Sufficient conditions are obtained to guarantee the realization of synchronization. Secondly, the synchronization problem of nonlinearly coupled and undirected network under the pinning control is studied, and a criteria of getting synchronization is given. Furthermore, we introduced the adaptive adjustment of the coupling strength in nonlinearly coupled network. At last, we give simulation examples to verify our theoretical results.

1 Introduction

In the past few years, complex networks have become a focal subject, which have aroused the concern of more and more scientists from many fields, such as physics, chemistry, biology, information technology, mathematics, and sociology, etc. (see [1–7]). Complex dynamical networks are ubiquitous in nature and have become an important part in our daily life. Therefore, the complex networks research have extremely vital significance in the real world.

Recently, studies on synchronization and control of complex networks have become a hot topic; many research methods and theoretical results have been reported in the literature, for example, [8–16]. To our knowledge, most of these papers are concerned with the synchronization and control problem of the undirected network (see [8–12]). However, it should be noticed that the directed network exists in every corner of the world and it is significant to study the synchronization of the directed network in real life. Moreover, a nonlinearly coupled network is important in practical applications, since the nodes state cannot be observed directly in some cases. Thus, it is necessary for us to pay attention to the synchronization of a nonlinearly coupled network.

In some cases, synchronization of the pinning complex network may be realized in theory, but it requires a large coupling strength, which is impractical. To solve this problem, adaptive technology is a efficient method to ensure the synchronization (see [14–21]). Different from the previous work, which mainly refers to the adaptive adjustment of coupling strength in a linearly coupled network (see [16–18]), the work we made is the adaptive adjustment of coupling strength

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