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OUTPUT SYNCHRONIZATION AND STABILITY ANALYSIS OF COMPLEX DYNAMICAL NETWORKS

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Abstract. *Description of network system only by state equations has some disadvantages: (1) sometimes system states are difficult to be observed and measured; (2) In most real network synchronization phenomena, all states are not necessary to achieve synchronization but only a part of states achieve synchronization which can satisfy the practical systems requirements. In order to overcome these disadvantages, output equations are introduced to describe network system and the definition of output synchronization is proposed. Then we consider two cases of the output matrix: singular and nonsingular matrix. And the stability of the output synchronization of complex networks is analyzed. Some sufficient conditions for output synchronization are shown in theorems and corollaries. Finally an example is provided to understand significant role of output synchronization in complex dynamical network systems.*

Keywords: Complex networks, State synchronization, Output synchronization, Stability analysis

1. **Introduction.** Today, complex networks have attracted increasing attention from various fields of science and engineering [1-3]. A complex network is a large set of interconnected nodes, in which a node is a fundamental unit that can have different meanings in different situations, such as chemical substrates, microprocessors, computers, schools, companies, papers, webs, people, and so on [2]. Examples of complex networks range from biological and chemical oscillators to electrical power grids and transportation networks, etc [2,3]. Due to the fact that there exist so many complex networks in our lives, it is necessary to study their operating mechanism, dynamic behavior, synchronous capabilities, anti-jamming ability, and so on [1-6].

Traditionally, complex networks were studied by graph theory, where a complex network is described by a random graph, for which the basic theory was introduced by Erdös and Rényi [7]. Recent years, Watts and Strogatz (WS) [8] introduced the concept of small-world networks to describe a transition from a regular lattice to a random graph. WS networks exhibit a high degree of clustering as in the regular networks and a small average distance between two nodes as in the random networks. Barabási and Albert [9] empirical results show that many large-scale complex networks are scale-free. Then, some researchers present many new models; such as local world evolving network model [10], weighted evolving networks presented by Barrat, Barthélemy, Vespignani (BBV) [11] and traffic driven evolution (TDE) networks [12], and so on.

Collective motions of complex networks have recently been the subject of considerable interest within the science and technology communities. Especially, one of the interesting and significant phenomena in complex dynamical networks is the synchronization of all