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SYNCHRONIZATION STABILITY FOR DISCRETE-TIME STOCHASTIC COMPLEX NETWORKS WITH PROBABILISTIC INTERVAL TIME-VARYING DELAYS

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Abstract. *The paper investigates the synchronization stability for discrete-time stochastic complex dynamical networks with probabilistic interval time-varying delays in the network coupling and in the dynamical nodes. Different from the common assumptions on the delay in the existing references, the delay in this letter is assumed to be random and its probability distribution is prior known. In terms of the probability distribution of the delays, the new type of system model with probability-distribution-dependent parameter matrices is proposed for the delay in the network coupling and in the dynamical nodes, the sufficient conditions for delay-dependent stochastic asymptotical synchronization stability are derived in the form of linear matrix inequalities, the solvability of derived conditions depends on not only the size of the delay, but also the probability of the delay taking values in some intervals. At last, a numerical example is given to illustrate the feasibility and effectiveness of the proposed method.*
Keywords: Stochastic complex networks, Synchronization stability, Time-varying delay, Probability distribution, Linear matrix inequalities (LMIs)

1. **Introduction.** Complex network models are often used to describe various interconnected systems of real world, such as the world wide web, food webs, electronic power grids, Internet, etc [2, 3, 4, 5]. Since the complexity of real world network, there are various complex network models used to study the dynamics of coupled systems. Synchronization is a basic motion in coupled dynamical networks which has been carefully studied in [6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18].

The characteristic of time-delayed coupling is very common in biological and physical systems, etc [19, 20, 21], some of time delays are trivial so can be ignored, while some others cannot be ignored, such as in long distance communication, traffic congestions, etc. Therefore, time delays should be modeled in order to simulate more realistic networks. Recently, Wang and Chen introduced a uniform dynamical network model and investigated its synchronization and control [22]. In [23], Li and Chen further extended the uniform dynamical network model to include coupling delays among the network nodes and studied its synchronization. Li [23] considered the synchronization stability of both continuous-time and discrete-time networks with coupling delays, which have further been improved in [24] by using less conservative delay-dependent techniques. A variational method has been used in [25] to deal with the synchronization problem for an array of linearly coupled identical connected neural networks with delays, whereas the similar problem has been addressed in [26] for an array of coupled nonlinear systems with delay and nonreciprocal time-varying coupling, more recently, by using Lyapunov