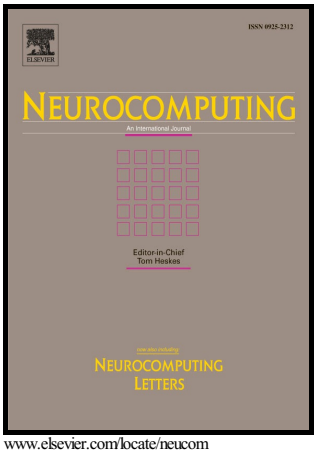

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Global asymptotic stability by complex-valued inequalities for complex-valued neural networks with delays on period time scales

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***Abstract*—By using Homeomorphism theory and some new inequality techniques, a novel LMI-based sufficient condition on global asymptotic stability of equilibrium point for complex-valued recurrent neural networks with time delays on period time scales is established. In our result, the assumption for boundedness in [25] on the complex-valued activation functions is removed and the matrix form of the square terms in [23] and [24] is replaced with a new matrix form, the complex-valued matrix inequalities in [25] and [26] are replaced with some new matrix inequalities which are derived from two new algebraic inequalities. Hence, our result on global stability is less conservative than those obtained in [25] and more novel than those obtained in [23]-[26].**

***Index Terms*—Complex-Valued recurrent neural networks on period time scales; Global asymptotic stability; The existence of equilibrium point; New inequalities; Homeomorphism theory**

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I. Introduction

A Complex-valued neural network is one that processes information in the complex plane: that is, its state, connection weight, and activation function are complex-valued. It has been found very useful in extending the scope of their applications in optoelectronics, filtering, imaging, speech synthesis, computer vision, remote sensing, quantum devices, spatiotemporal analysis of physiological neural devices and system, and artificial neural information processing [1]-[7].

In recent years, the global stability of complex-valued neural networks has been widely studied, for example, see [1]-[4],[6],[8]-[12], [13]-[16], [30]-[32]. In [1], a complex-valued recurrent neural network with time delays was investigated based on two classes of complex-valued activation functions. In [2], applying delta differential operator, a complex-valued neural network on time scales was studied. In [3], by separating complex-valued neural networks into real and imaginary parts, forming an equivalent real-valued system, and constructing appropriate Lyapunov functional, a sufficient condition to ensure the global asymptotic stability of the equilibrium point of complex-valued neural networks was provided. In [4], based on the new condition and linear matrix inequality, some new criteria to ensure the existence, uniqueness and global asymptotic stability of the equilibrium point of complex-valued RNNs with time delays were established. The discrete-time delayed complex-valued neural networks have been studied , respectively, and several criteria on the boundedness, global exponential stability or global μ stability were established in [8], [9] and [30]. In [17], by using two matrix inequalities, a LMI-based global asymptotical stability condition was obtained for complex-valued neural networks with probabilistic time-varying delays. In [13], global exponential stability results in inequality form for complex-valued recurrent neural networks with asynchronous time delays were investigated by proving the convergence directly using ∞-norm, 1-norm, and 2-norm, respectively. In [14], based on the matrix measure method and the Halanay inequality, global exponential stability result in inequality form was investigated for complex-valued recurrent neural networks with time-varying delays. In [15], the problem of global μ stability for complex-valued neural networks with unbounded time-varying delays was considered and complex-valued LMIS and real LIMS were obtained on global μ stability by an appropriate Lyapunov-krasovskill functional and linear matrix inequalities. In [18], by using inequality technique, some LMI-based conditions on global asymptotic stability of equilibrium point for a class of complex-valued neural networks were obtained. In [31], by using differential inequality, sufficient conditions were obtained on global exponential stability of equilibrium point for a class of complex-valued neural networks with both time-varying and impulsive effects. In [32], by using linear matrix inequality, global stability results were established for equilibrium point of a class of complex-valued BAM neural networks.

In recent years, the existence and global stability of equilibrium point or periodic solutions of neural networks on time scales have been studied, for example, see [19-24].

However, so far, only ([2], [25], [26]) have discussed the stability of complex-valued neural networks on time scales. In [2], by using fixed point theorem and Lyapunov functional, the authors obtained global exponential stability result in inequality form of equilibrium point for a complex-valued neural networks on time scales. In [26], the complex-valued neural networks with both leakage time and discrete time delay as well as types of activation functions on time scales were considered. By using the fixed point theory, appropriate Lyapunov functionals and emplying the free weight matrix method , sufficient conditions on global exponential stability were obtained. In [25], the problem on global exponential stability of complex-valued neural networks with both leakage

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