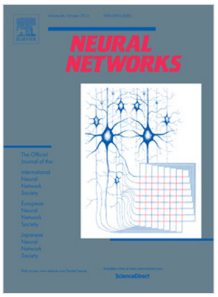

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Existence and finite-time stability of discrete fractional-order complex-valued neural networks with time delays

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Abstract

Without decomposing complex-valued systems into real-valued systems, the existence and finite-time stability for discrete fractional-order complex-valued neural networks with time delays are discussed in this paper. First of all, in order to obtain the main results, a new discrete Caputo fractional difference equation is proposed in complex field based on the theory of discrete fractional calculus, which generalizes the fractional-order neural networks in the real domain. Additionally, by utilizing Arzela-Ascoli's theorem, inequality scaling skills and fixed point theorem, some sufficient criteria of delay-dependent are deduced to ensure the existence and finite-time stability of solutions for proposed networks. Finally, the validity and feasibility of the derived theoretical results are indicated by two numerical examples with simulations. Furthermore, we have drawn the following facts: with the lower order, the discrete fractional-order complex-valued neural networks will achieve the finite-time stability more easily.

Keywords: Existence; Discrete time; Fractional-order complex-valued neural networks; Finite-time stability; Delays

1. Introduction

Fractional-order calculus, as the extension of integer-order calculus, was initially established by Leibniz in 1695. There are many masters of mathematics such as Liouville, Riemann, Abel, Fourier, who have spent many years on developing and perfecting its theory, constantly (Podlubny, 1999). As the deepening of the theoretical research, fractional-order calculus has been diffusely applied in science and engineering (Park et al., 2008; Park, 2006), such as signal processing, control systems and associative memory. Compared with classical integer-order systems, the unique advantage of fractional-order system is that it offers an excellent instrument for the description of memory and hereditary properties of various materials and processes (Trigeassou et al., 2011; Kwon et al., 2014; Stamova, 2014b; Lenka & Banerjee, 2016; Thanh et al., 2017). Based on this feature, fractional-order cellular neural networks were first proposed by Arena, Caponetto, Fortuna & Porto (1998). However, when the fractional-order neural networks are used in hardware implementation of the system, time delay is frequently occurred and has a detrimental effect on the

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