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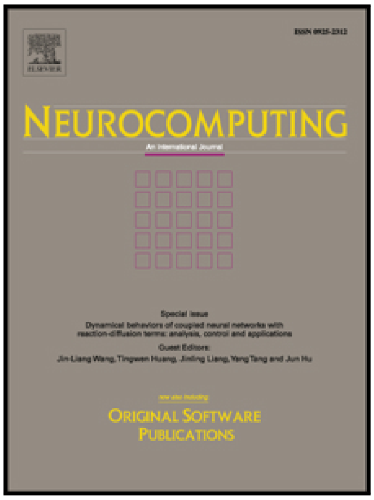

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Finite-time stability analysis of fractional-order complex-valued memristor-based neural networks with both leakage and time-varying delays

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Abstract

Finite-time stability of a class of fractional-order complex-valued memristor-based neural networks with both leakage and time-varying delays is investigated in this paper. By employing the set-valued map and differential inclusions, the solutions of memristor-based system are intended in Filippov's sense. Via using Hölder inequality, Gronwall-Bellman inequality and inequality scaling skills, sufficient conditions to guarantee the stability of the system are derived when $0 < \alpha < \frac{1}{2}$ and $\frac{1}{2} \le \alpha \le 1$, respectively. Finally, two numerical examples are designed to illustrate the validity and feasibility of the obtained results.

Keywords: Fractional-order complex-valued neural networks; Equilibrium point; Memristor; Leakage delay; Time-varying delays; Finite-time stability

I. Introduction

The fractional calculus is an extension of the integer-order differential and integral [1]. It can deal with differential and integrals of any arbitrary order. Because of the property of infinite memory, fractional-order calculus has been applied on neural networks [2]. Since many systems can be more accurately described by fractional calculus, some researchers put forward fractional-order neural networks [3]. In the past decades, neural networks have received much attention because of their applications in various fields such as signal processing, image processing, control systems and associative memory. Recently, various classes of neural network models have been investigated [4]-[13]. Furthermore, linear or nonlinear systems have been extensively studied [14]- [19]. The stability analysis for fractional-order neural networks is becoming one of the most popular research fields, such as finite-time stability [20]- [23], global asymptotic stability [24]- [26], global Mittag-Leffler stability [27]- [29]. In [21], some finite-time stability results for a class of fractional-order neural networks with constant delay were derived by using Hölder inequality, Gronwall inequality and inequality scaling skills. In [28], the second method of Lyapunov in the fractional-order case was extended and a useful inequality was established which could be effectively used to analyze the Mittag-Leffler stability of fractional-order Hopfield neural networks without delay. A set of sufficient conditions were derived to guarantee the stability.

It was known that memristor is a nonlinear resistor with memory and can memorize the direction that electric charge flowed through in the past [30]. Recently, the memristor-based neural networks were presented which are a class of differential dynamic systems whose coefficients depended on the states. The right hands of this kind of dynamic systems are discontinuous, which could easily lead to complex nonlinear behavior and switch uncertainty

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