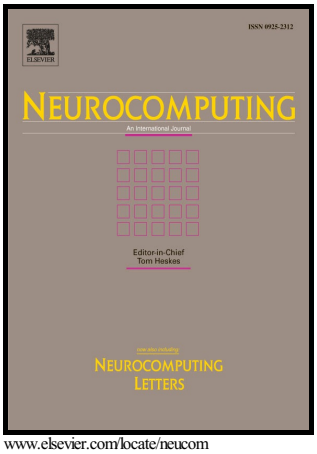

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On the periodic dynamics of a memristor-based neural networks with leakage and time-varying delays

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Abstract

In this paper, the periodic dynamics have been studied for a general kind of memristor-based neural networks with leakage and time-varying delays. Some new sufficient conditions have been derived ensuring that the existence, uniqueness and globally exponential stability of the periodic solution for the neural network by using differential inclusions theory, the topological degree theory in set-valued analysis and Lyapunov function technique and so on. As a special case, we have shown that the existence, uniqueness and global exponential stability of equilibrium point for the autonomous neural networks with leakage delays.

Keywords: Memristor-based neural networks, Leakage delays, Time-varying delays, Periodic solution, Global exponential stability.

1. Introduction

A new concept and a new circuit element, memristor, postulated by Prof.Chua [1] in 1971 and a team at HP Labs [2] in 2008, respectively. From then on, the memristor behavior plays a prominent part in the design of integrated circuit [3-4], where the memristor may be used as a nonvolatile memory switch [5-7]. Recently, there are many more physical realization of memristors and memristive systems [8], the modeling of basic memristor circuits [9], the designs and analysis of memristor-based application circuits [10], etc., have attracted much attention in the electrical and electronic engineering communities due to the potential applications of this device in next generation computer and powerful brain-like neural computer.

The memristor-based neural networks is a new kind of neural networks model, where the connection weights change according to its state, for example, a state-dependent switching neural networks. The analysis of the memristor-based neural networks has been found useful to address a number of interesting engineering tasks, such as dry friction, impacting machines, systems oscillating under the effect of an earthquake, power circuits, switching in electronic circuits and many others, and therefore have received a great deal of attention in the literature [11-28] and the references therein.

In many applications, knowing the property of periodic oscillatory solutions is very interesting and valuable. For example, as many biological and cognitive activities (e.g., heartbeat, respiration, mastication, locomotion, and memorization) require repetition. An equilibrium point can viewed as a special case of periodic solution with an arbitrary period or zero amplitude. In this sense, the analysis of periodic oscillation of neural networks is more general than the stability analysis of equilibrium points. Meanwhile, the delays are actually encountered in practical implementation, due to the finite switching speed of the neuron amplifiers and the finite signal propagation speed. There have been many results on the stability and the periodicity analysis of recurrent neural networks with and without delays in [29-31] and references therein. It is necessary to point out that the global periodicity and global stability of the delayed memristor-based recurrent neural networks (DMNN) plays also important roles in many

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