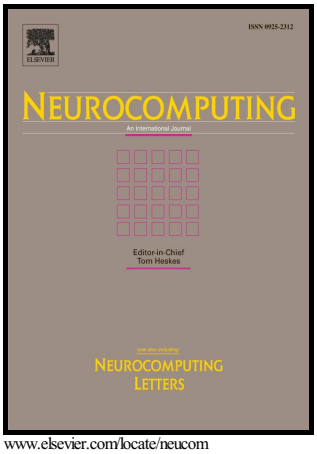

www.elsevier.com/locate/neucom

Finite-time Mittag-Leffler synchronization of fractional-order memristive BAM neural networks with time delays

Jianying Xiao, Shouming Zhong, Yongtao Li, Fang Xu

PII: S0925-2312(16)31084-0
DOI: http://dx.doi.org/10.1016/j.neucom.2016.09.049
Reference: NEUCOM17578

To appear in: *Neurocomputing*

Received date: 16 March 2016
Revised date: 12 September 2016
Accepted date: 22 September 2016

Cite this article as: Jianying Xiao, Shouming Zhong, Yongtao Li and Fang Xu Finite-time Mittag-Leffler synchronization of fractional-order memristive BAM neural networks with time delays, *Neurocomputing* http://dx.doi.org/10.1016/j.neucom.2016.09.049

Finite-time Mittag-Leffler synchronization of fractional-order memristive BAM neural networks with time delays☆

Jianying Xiao[a,b,*], Shouming Zhong[b], Yongtao Li[c], Fang Xu[a]

[a]School of Sciences, Southwest Petroleum University, Chengdu, 610050, PR China
[b]School of Mathematical Sciences, University of Electronic Science and Technology of China, Chengdu, 611731, PR China
[c]College of Chemistry and Chemical Egineering, Southwest Petroleum University, Chengdu, 610050, PR China

Abstract

This paper investigates the finite-time synchronization of delayed fractional-order memristive bidirectional associative memory neural networks (FMBAMNNs). Based on Lyapunov theory, fractional-order differential inequalities, norm properties and linear feedback controller, the separated criteria are obtained to ensure the finite-time synchronization of studied FMBAMNNs with different fractional order α, respectively. Moreover, the derived criteria are easily checked and they contribute to the reduction of amount of calculation. Finally, two numerical examples are given to demonstrate the effectiveness of the theoretical results.

Keywords:
Memristor, Fractional-order neural networks, Synchronization, Bidirectional associative memory.

1. Introduction

Fractional calculus as an extension of usual calculus dates from the late seventeenth century and it is regarded as a generalization of derivation and integration of arbitrary order ([1]). Compared with integer-order systems, fractional-order ones have apparent advantages in describing the memory and hereditary properties of different kinds of materials and processes. Moreover, fractional-order systems are more likely to be used to describe most of the real-world behaviors than integer-order ones because they can provide more practical value and accurate results. Therefore, many researchers have paid close attention to studying the dynamical behaviors of fractional-order systems and have drawn some wonderful results in the literature ([2-15,20-27,33-38,56-57]).

In the past several decades, bidirectional associative memory neural networks (BAMNNs) have been successfully applied in the filed of artificial intelligence and pattern recognition because they generalize the single-layer auto-associative Hebbian circuit to a two-layer pattern matched hetero-associative correlation ([47-51]). The two-layer pattern matched hetero-associative circuit can help BAMNNs store and recall pattern pairs which are regarded as the bidirectionally stable states ([47]). Accordingly, the reverberating interfered message between the two-layer circuit would be unavoidably involved in the information which is derived by decoding in BAM. That way, some hereditary properties present in this kind process of intelligent information. Given that fact, it is very important to take into account merging infinite memory into BAMNNs as the authors suggested in ([19]). On one hand, BAMNNs can be realized in a circuit where the self-feedback connection weights and the common connection weights are established by memristors. The memristor which was found by Chua ([28]) is well-known as the fourth fundamental nonlinear circuit element. The other three basic nonlinear circuit elements are capacitor, inductor and resistor. Almost forty years later, a group of scientists from Hewlett-Packard library identified the memristor and employed it to build the prototype with the nanometer size ([29]). Since then, the memristor has been substituted for resistor to emulate neural synapses in analog circuits because it owns memory and performances more like biological synapses than the resistor. There are many papers which verify that the memristor possesses the characteristic of pinched hysteresis. Owe to this characteristic, some researchers establish a new class of NNs named memristive or memristor-based neural networks (MNNs) by replacing resistors with memristors ([39-42,44,50,51,54]). Very recently, based on nonsmooth analysis ([30,31]), some authors studied memristive or memristor-based BAM neural networks (MBAMNNs) and investigated the various dynamical behaviors of BAMMNNs in order to realize their better applications in associative memories, neural learning and pattern recognition ([45,50,51]). On the other hand, as we shared at the beginning, fractional-order systems possess infinite memory and hereditary properties. In addition, time delays inevitably exist in dynamical systems and they may initiate undesirable dynamical behaviors such as divergence, oscillation, even or instability. Therefore, many researches about several dynamical behaviors of NNs with time delays become more and more significant and popular. From the above three perspectives, it is necessary to develop some economical and practical systems for fractional-order memristive bidirectional

☆This work was supported by National Natural Science Foundation of China (61202045 and 11401494)

*Corresponding author: School of Sciences, Southwest Petroleum University, Chengdu, 610050, PR China.
Email address: shawion1980@yahoo.com (Jianying Xiao)