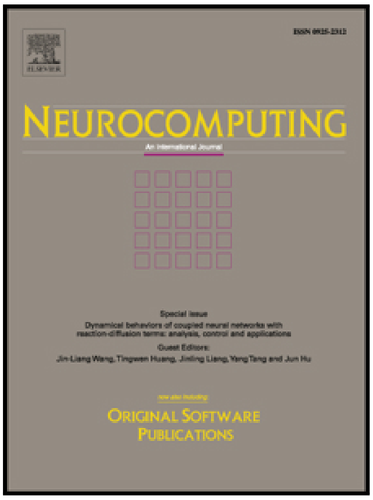
Communicated by Dr. Derui Ding

# Accepted Manuscript




Finite-time synchronization for Cohen-Grossberg neural networks with mixed time-delays

Dongxue Peng, Xiaodi Li, Chaouki Aouiti, Foued Miaadi

PII: S0925-2312(18)30294-7
DOI: 10.1016/j.neucom.2018.03.008
Reference: NEUCOM 19410

To appear in: *Neurocomputing*

Received date: 16 December 2017
Revised date: 2 February 2018
Accepted date: 1 March 2018

Please cite this article as: Dongxue Peng, Xiaodi Li, Chaouki Aouiti, Foued Miaadi, Finite-time synchronization for Cohen-Grossberg neural networks with mixed time-delays, *Neurocomputing* (2018), doi: 10.1016/j.neucom.2018.03.008

# Finite-time synchronization for Cohen-Grossberg neural networks with mixed time-delays ☆

**Dongxue Peng[a], Xiaodi Li[a,b,*], Chaouki Aouiti[c], Foued Miaadi[c]**

[a] *School of Mathematics and Statistics, Shandong Normal University, Ji'nan, 250014, PR China*
[b] *Institute of Data Science and Technology, Shandong Normal University, Ji'nan, 250014, PR China*
[c] *University of Carthage, Faculty of Sciences of Bizerta, Department of Mathematics, Research Units of Mathematics and Applications UR13ES47, Zarzouna 7021, Bizerta, Tunisia*

**Abstract**

This paper aims to study the finite-time synchronization (i.e., synchronization in finite-time sense) of Cohen-Grossberg neural networks with mixed time delays (both time-varying discrete delay and infinite-time distributed delay). By constructing Lyapunov-Krasovskii functional candidates and using inequality techniques, some new sufficient conditions are derived to design the discontinuous state feedback controllers such that the addressed neural networks can be synchronized in a finite settling time, where the upper bounds of the settling time of synchronization are estimated. The effects of unknown or known time-delay are seriously taken into account, respectively, which lead to two different delay-independent discontinuous state feedback controllers. Thus our results can be applied to the finite-time synchronization of neural networks whether the time delay can be measured or not. As some special cases, our results also improve some recent works. Simulation results show the applicability and the advantages of the proposed finite-time controllers.

*Keywords:* Finite-time synchronization; Cohen-Grossberg neural networks; Mixed delays; Lyapunov-Krasovskii functional.

## 1. Introduction

In recent years, several artificial neural networks, including cellular neural networks, Hopfield neural networks and Cohen-Grossberg neural networks, have obtained the unprecedented development and have been widely studied in the dynamical behaviors such as stability [1–4], state estimations [5] and boundedness [6–8], periodicity [9, 10], and synchronization [11–14]. As one of the most popular and typical neural network models, Cohen-Grossberg neural network has attracted considerable attention due to its distinguished applications in classification, parallel computing, signal and image processing since its emergence in 1983 by Cohen and Grossberg [15]. This model includes a lots of classical models from evolutionary theory, population biology and neurobiology. Especially, it should be pointed out that the Cohen-Grossberg neural network encompasses the Hopfield neural network as a special case. In recent years, the dynamical behavior of Cohen-Grossberg neural network with or without time delays have been extensively studied, see [16–20] for instance.

Especially, the synchronization of Cohen-Crossberg neural networks with time delays has attracted much attention. As we know, the study of synchronization for neural networks with time delay is not an easy work, since such model is a class of infinite dimensional systems and usually admits complicated structures [21–23]. Moreover, it was observed both experimentally and numerically in [24] that the effects of time delay on system dynamics are bilateral, i.e., it could induce instability, causing sustained oscillations which may be harmful to a system and it also, inversely, make an unstable system stable and achieve some desired performances. Until now, various synchronization control of Cohen-Crossberg neural networks with time delays have been presented, see [25–28] for recent works. In [25], the exponential synchronization of Cohen-Grossberg neural networks with time-varying delays were studied by designing a periodically intermittent controller. In [26], the adaptive synchronization of Cohen-Grossberg neural networks with mixed time-varying delays and stochastic perturbation were studied based on the LaSalle invariant principle. In [27], authors considered the lag synchronization for Cohen-Grossberg neural networks with mixed time-delays via periodically intermittent control. [28] dealt with the problem of function projective synchronization for a class of memristor-based Cohen-Grossberg neural networks with time-varying delays.

Note that the above mentioned works on synchronization control are based on the fact that the trajectories between the response system and drive system can achieve the synchronization over the infinite horizon. In the application point of view, it is more realistic if the synchronization control could be re-

☆This work was supported by National Natural Science Foundation of China (11301308, 61673247), and the Research Fund for Distinguished Young Scholars and Excellent Young Scholars of Shandong Province (JQ201719, ZR2016JL024). The paper has not been presented at any conference.

*Corresponding Author.
Email address: lxd@sdnu.edu.cn (X.Li)