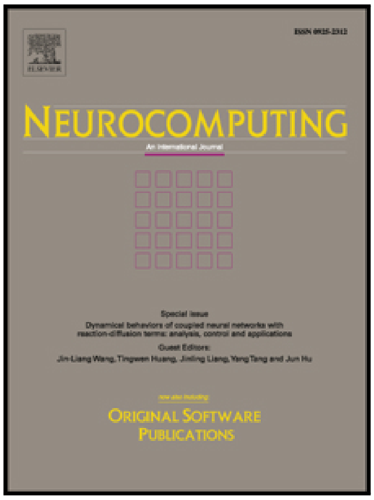
Communicated by Xiaojie Su

Accepted Manuscript



Exponential passivity for uncertain neural networks with time-varying delays based on weighted integral inequalities

S. Saravanan, V. Umesha, M. Syed Ali, S. Padmanabhan

PII: S0925-2312(18)30835-X
DOI: 10.1016/j.neucom.2018.07.009
Reference: NEUCOM 19757

To appear in: *Neurocomputing*

Received date: 28 March 2017
Revised date: 10 April 2018
Accepted date: 2 July 2018

Please cite this article as: S. Saravanan, V. Umesha, M. Syed Ali, S. Padmanabhan, Exponential passivity for uncertain neural networks with time-varying delays based on weighted integral inequalities, *Neurocomputing* (2018), doi: 10.1016/j.neucom.2018.07.009

Exponential passivity for uncertain neural networks with time-varying delays based on weighted integral inequalities

S. Saravanan[a] V. Umesha[b], M. Syed Ali [a] *and S. Padmanabhan[c]
[a] Department of Mathematics, Thiruvalluvar University, Vellore - 632 115, Tamilnadu, India.
[b] Dayananada Sagar College of Engineering, Bangalore, 560078.
[c] RNS Institute of Technology, Channasandra, Bangalore, 560098.

Abstract: This paper is concerned with the problem of an exponential passivity analysis for uncertain neural networks with time-varying delays. By constructing an appropriate Lyapunov-Krasovskii functional and using the weighted integral inequality techniques to estimate its derivative. We established a sufficient criterion such that, for all admissible parameter uncertainties, the neural network is exponentially passive. The derived criteria are expressed in the terms of linear matrix inequalities (LMIs), that can be easily checked by using the standard numerical software. Illustrative examples are presented to demonstrate the effectiveness and usefulness of the proposed results.

Key Words: Lyapunov-Krasovskii functional (LKF), Neural networks, Passivity, Time-varying delays, Uncertainity, Weighted integral inequalities.

1 Introduction

Many practical network systems, such as image processing, communication, fault diagnosis, fixed-point computations, parallel computations, and industrial automation can be modeled as neural networks (NNs) with time delay. Time delays area unit ineluctably gift as a result of the finite switching speeds of the amplifiers and also the inherent communication time of neurons, and its existence can have an effect on the stability of a framework by making oscillating and instability characteristics [1]–[6]. The existence of time-delayed signals in systems may cause divergence, instability and the gradual degradation of the system performance. The appearance of time delay in these network systems may make them unstable. Hence, for time-delay systems, stability analysis is an important issue to be considered [7]–[17]. In general, the stability analysis can be grouped into two classes, namely the asymptotic stability analysis [18]–[20] and the exponential stability analysis [21, 22]. Thus the issue of stability analysis for neural framework with time-varying delays are investigated via LMI technique by many authors [23]–[29].

On the other hand, in the hardware implementation of neural networks, the network parameters of the neural system may be subjected to some changes due to the tolerances of electronic components employed in the design. The stability of several neural networks with above two types of uncertainties was analyzed [30]–[33]. When one models real nervous systems, parameter uncertainty is a unit ineluctable to be thought about. As a result, the connection weights of the neuron depend upon bound resistance and capacitance values that embody uncertainties. Therefore, it is of sensible importance to review the stability of neural frameworks with parameter uncertainties, some excellent results of uncertainty have been presented in [34]-[38]. In the first place, many systems need to be passive in

*Corresponding author. E-mail address: saravanantvu@gmail.com(S. Saravanan), syedgru@gmail.com (M. Syed Ali)