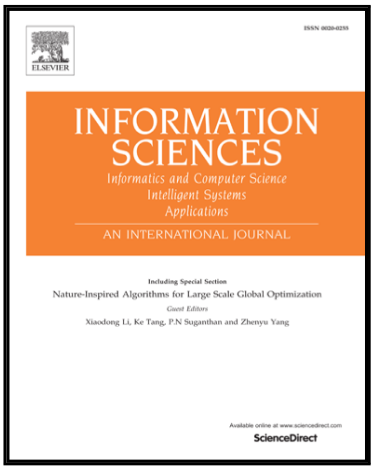

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Extended Dissipativity Analysis for Discrete-Time Delayed Neural Networks Based on an Extended Reciprocally Convex Matrix Inequality

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Abstract

In this paper, the extended dissipativity analysis for discrete-time neural networks with a time-varying delay is investigated. First, a novel Lyapunov-Krasovskii functional (LKF) is constructed with a delay-product-type term introduced. Then, in the forward difference of the LKF, the sum terms are bounded via an extended reciprocally convex matrix inequality. As a result, an extended dissipativity criterion is established in terms of linear matrix inequalities. Meanwhile, this criterion is extended to the stability analysis of the counterpart system without disturbance. Finally, two numerical examples are given to demonstrate the effectiveness and improvements of the presented criterion.

Keywords: Discrete-time neural networks, Extended dissipativity, Extended reciprocally convex matrix inequality, Time-varying delay.

1. Introduction

Neural networks have attracted many researchers' attention since they have been successfully applied in various areas such as signal transmission, pattern recognition, associative memory, *etc*. [2, 29]. In engineering applications, although the discrete systems cannot present the dynamic behaviors of the continuous counterparts even for a short sampling period, it is essential to formulate discrete-time neural networks that are analogue of continuous ones [16]. Inevitably, there do exist time delays during the process of information transmission between the neurons, which often leads to undesired characteristics [30]. Therefore, it is necessary to investigate the stability and robust performance of discrete-time delayed neural networks (DNNs) so as to improve their application to practice [7].

The main method for the stability analysis of discrete-time DNNs [8, 15, 17, 22] is the Lyapunov direct method. Based on this method, many stability criteria are developed via constructing a suitable Lyapunov-Krasovskii functional (LKF) and/or tightly estimating the forward difference of the LKF [28]. Hence, this research aims to obtain less conservative stability criteria with small computation complexity. To this end, numerous approaches were presented. In the terms of LKFs, the simple LKF [15, 22], the delay segmented LKF [17] and the augmented LKF [8] have been constructed. Then, for estimating the forward difference of the LKF effectively, some bounding techniques have been proposed. For instance, the free weighting matrix (FWM) technique [27], the discrete Jensen's inequality [32], the reciprocally convex combination lemma (RCCL) [13], the zero equations [8], the discrete Wirtinger-based inequality [14] and the free-matrix-based integral inequality [6, 20], *etc.* have been presented in existing results.

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