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Original article

LMI criteria on exponential stability of BAM neural networks with both time-varying delays and general activation functions

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Abstract

In this paper, the exponential stability analysis for the bidirectional associative memory neural network model with both time-varying delays and general activation functions is considered. Neither the boundedness and the monotony on these activation functions nor the differentiability on the time-varying delays are assumed. By employing Lyapunov functional and the linear matrix inequality (LMI) approach, several new sufficient conditions in LMI form are obtained to ensure the existence, uniqueness and global exponential stability of equilibrium point for the neural networks. Moreover, the exponential convergence rate index is estimated, which depends on the system parameters. The proposed stability results are less conservative than some recently known ones in the literature, which is demonstrated via an example with simulation.

Keywords: BAM neural networks; Time-varying delays; Exponential stability; Linear matrix inequality

1. Introduction

The bidirectional associative memory (BAM) neural network model was first introduced by Kosko [10]. This class of neural networks have been successfully applied to pattern recognition, signal and image processing, artificial intelligence due to its generalization of the single-layer auto-associative Hebbian correlation to a two-layer pattern-matched hetero-associative circuits. Some of these applications require that the designed network has a unique stable equilibrium point [7].

In hardware implementation, time delays occur due to finite switching speed of the amplifiers and communication time [26]. Time delays will affect the stability of designed neural networks and may lead to some complex dynamic behaviors such as periodic oscillation, bifurcation, or chaos [6]. Therefore, study of neural dynamics with consideration of the delayed problem becomes extremely important to manufacture high quality neural networks. Some results concerning the dynamical behavior of BAM neural networks with delays have been reported, for example, see [33,11,9,29,35,36,4–6,12,21,22,25,23,24,7,28,32,27,31,1,3,20,2,26,37,13,19,34,15] and references therein. The circuits diagram and connection pattern implementing for the delayed BAM neural networks can be found in [6]. In

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