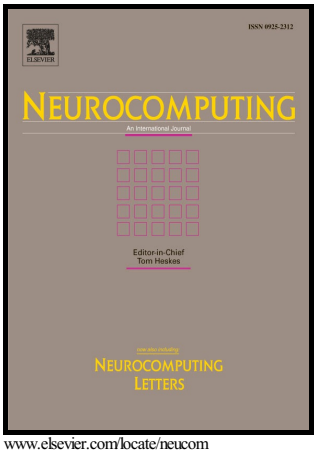

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State estimation and input-to-state stability of impulsive stochastic BAM neural networks with mixed delays☆

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Abstract

This paper concerns with dynamical behaviors for a class of impulsive BAM neural networks with stochastic effects and mixed delays. By establishing integral-differential inequalities with time-varying inputs, we give the pth moment state estimation and obtain some sufficient conditions ensuring pth asymptotical input-to-state stability and pth exponential input-to-state stability with variable gains for the impulsive stochastic neural networks with delays. The present approach can remove some conservative and restrictive conditions on input-to-state stability given in existing publications and extend to more general stochastic delayed systems with nonlinear impulses.

Keywords: BAM neural networks; Input-to-state stability (ISS); Integral-differential inequalities; Time delays; Impulses; Stochastic effects.

1. Introduction

The bidirectional associative memory (BAM) neural networks were initially introduced by Kosko in [1, 2] and applied in various areas in science and technology such as pattern recognition, image processing, optimization and so on. In the evolution of neural networks, there are three common phenomena including stochastic noise, impulsive effects and time delays. Stochastic noise is nearly inevitable in real nervous systems since the synaptic transmission is a noisy process brought on by random fluctuations from the release of neurotransmitters and other probabilistic causes (see, e.g., [3, 4]). Meanwhile, the networks are likely to exhibit impulsive effects when system states are subject to instantaneous perturbations and experience critical changes at certain instants, which may be caused by switching, abrupt frequency change or other sudden disturbance (see, e.g.,[5, 6, 7]). Besides, time delays always occur in the process of information storage and transmission in real neural networks on account of the finite switching speed of amplifiers (see also, e.g.,[8, 9, 10]). Recently, impulsive stochastic BAM neural networks with time delays have attracted the attention and some results on stability of the equilibrium point or periodic solutions in Lyapunov sense have been reported in [11]-[18], etc..

It is well known that state estimation is the most basic and useful technique of analyzing dynamic behavior of neural networks [19, 20, 21], which widely adopted for analyzing the stability, passivity, synchronization and so on (see also, e.g., [22, 23, 24, 25]). In 1990's, Sontag[26, 27] first introduced the concept of input-to-state stability (ISS) in form of a special state estimation for nonlinear systems with external inputs, which means that the system states should remain bounded when its inputs are bounded, and tend to zero when inputs tend to zero. The ISS plays an important role in the dissipativity analysis of nonlinear dynamical systems with inputs and some interesting extensions of the ISS have been intensively investigated in recent years (see also, e.g.,[26]-[33]). Since external inputs are usually time-varying and there exist impulsive and stochastic perturbations in neural networks, it may be unreasonable to

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