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Mean square exponential stability of impulsive stochastic reaction-diffusion Cohen–Grossberg neural networks with delays

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Abstract

In this paper, we establish a method to study the mean square exponential stability of the zero solution of impulsive stochastic reaction-diffusion Cohen–Grossberg neural networks with delays. By using the properties of M-cone and inequality technique, we obtain some sufficient conditions ensuring mean square exponential stability of the zero solution of impulsive stochastic reaction-diffusion Cohen–Grossberg neural networks with delays. The sufficient conditions are easily checked in practice by simple algebra methods and have a wider adaptive range. Two examples are also discussed to illustrate the efficiency of the obtained results.

Keywords: Mean square exponential stability; Impulsive; Stochastic reaction-diffusion system; Delays

1. Introduction

Since Cohen–Grossberg neural network was first proposed by Cohen and Grossberg [7] in 1983, many researchers have done extensive works on this subject due to their extensive applications in many fields such as pattern recognition, parallel computing, associative memory, signal and image processing and combinatorial optimization. In such applications, it is of prime importance to ensure that the designed neural networks is stable. The stability analysis problem for Cohen–Grossberg neural networks has gained much research attention, and a large amount of results related to this problem have been published, (see, e.g., [5,14,17,19,30,32,24,20,27]).

However, strictly speaking, diffusion effects cannot be avoided in the neural networks when electrons are moving in asymmetric electromagnetic fields. Therefore we must consider that the activations vary in space as well as in time. In [15,16,25,33,13], the authors have considered the stability of neural networks with reaction-diffusion terms.

On the other hand, a real system is usually affected by external perturbations which in many cases are of great uncertainty and hence may be treated as random, as pointed out by Haykin [12] that in real nervous systems, the synaptic transmission is a noisy process brought on by random fluctuations from the release of neurotransmitters and other probabilistic causes. It has also been known that a neural network could be stabilized or destabilized by certain

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