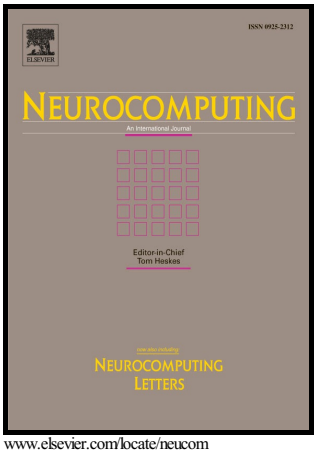

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SICNNs with Li-Yorke Chaotic Outputs on a Time Scale

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Abstract

The existence of Li-Yorke chaos in the dynamics of shunting inhibitory cellular neural networks (SICNNs) on time scales is investigated. It is rigorously proved by taking advantage of external inputs that the outputs of SICNNs exhibit Li-Yorke chaos. The theoretical results are supported by simulations, and the controllability of chaos on the time scale is demonstrated by means of the Pyragas control technique. This is the first time in the literature that the existence as well as the control of chaos are provided for neural networks on time scales.

Keywords: Shunting inhibitory cellular neural networks; Time scales; Li-Yorke chaos; Proximality; Frequent separation; Chaos control.

1. Introduction

Shunting inhibitory cellular neural networks (SICNNs), which is a class of cellular neural networks, have been extensively investigated beginning with the study of Bouzerdoum and Pinter [1]. SICNNs have an exceptional role in psychophysics, speech, perception, robotics, adaptive pattern recognition, vision, and image processing. We refer the reader to [1] for the derivation of this type of neural networks and their description in the most original form. Another subject that is also popular is the theory of time scales, which was first presented by Hilger [2]. This theory has many applications in various scientific fields, and neural networks are no exception [3]-[11].

The first mathematically rigorous definition of chaos was introduced by Li and Yorke [12]. It was shown in [12] that if a map on an interval has a point of period three, then it possesses chaos. The presence of an uncountable scrambled set is a distinguishing feature of the Li-Yorke chaos. It was demonstrated by Marotto [13] that a multidimensional continuously differentiable map is Li-Yorke chaotic provided that it

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