Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **9 (2002)** 39-58

Time Delays and Stimulus Dependent Pattern Formation in Periodic Environments in Isolated Neurons – II

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Abstract. The dynamical characteristics of an isolated Hopfield-type neuron with time delays under periodic external stimuli are studied. The study is focused on neurons having periodic parameters with discrete and continuously distributed delays. Delay-independent sufficient conditions for the stable encoding of periodic external stimuli are established. The results of this article extend and generalize those obtained by the authors recently in IEEE Trans. Neural Networks (to appear).
Keywords. Hopfield-type neural network, time delays, periodic environments, exponential stability.
AMS (MOS) subject classification: 34K13, 34K20, 92B20.

1 Introduction

Models of artificial neural networks which act as stable encoders have attracted considerable interest recently. When a temporally uniform or a slowly varying input is delivered to such networks, they evolve and reach a static or dynamic equilibrium. Such systems are of interest in modelling certain biological processes. For instance the work of Juliano, et.al. [13], Whitsel, et.al. [18], Whitsel and Kelly [19] on the encoding of input stimuli by mammalian sensory cortex indicates that the cortical response to repeated stimulation is stimulus-specific. Furthermore it has been reported (see Eckhorn, et.al. [3], Gray, et.al. [10], Engel, et.al. [4]) that assemblies of cells in the visual cortex oscillate synchronously in response to external stimuli. Such a synchrony is a manifestation of the encoding process of temporally varying external stimuli. Ott, et.al. [16] have shown that one can convert a chaotic attractor to any one of a large number of possible time periodic motions by the introduction of time dependent perturbations to the network parameters.

The following discussion will be of some benefit to the readers – to orient the readers toward the relevant literature. The experimental and theoretical studies of Skarda and Freeman [17] and Freeman [6] suggest that a mammal's brain may be exploiting dynamic attractors for its encoding and subsequent associative recall rather than temporally static (equilibrium-type) attractors