NEURAL NETWORKS AND OSCILLATIONS

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1. Abstract

MANY scientific studies have proven that an animal continuously senses its environment via different perceptual means and integrates the sensory information to adapt its behavior. The temporal aspect of this integration is fundamental for the sensory perception. A population of neurons makes a success of this dynamic integration by an intricate combination of synchronization of potential of action and recurring connections.

Inspired by this biological mechanism, recurrent neural networks (RNNs) are believed to be a powerful sequence processing method. Recurrent interactions among large populations of neurons are expected to yield collective phenomena adapted for dealing with temporal behavior.

The stability of dynamical systems in presence of time-delay is a problem of big interest since the presence of a time-delay may induce instabilities, and complex behaviors for the corresponding schemes. In particular, the problem becomes even more difficult in the case when the delays are distributed.
Besides, as we all know, many phenomena in nature have oscillatory character and their mathematical models have led to the introduction of certain classes of functions to describe them. Such a class form pseudo almost periodic functions which a natural generalization of the concept of almost periodicity.

This paper is concerned with the existence and uniqueness of pseudo almost-periodic solutions and/or pseudo almost-automorphic solutions to some delayed neural networks. Several conditions guaranteeing the existence and uniqueness of such solutions are obtained in a suitable convex domain. Furthermore, several methods are applied to establish sufficient criteria for the globally exponential stability of the considered models.

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