Dynamics of Continuous, Discrete and Impulsive Systems
Series **A:** *Mathematical Analysis* **13 (2006)** 713-736

QUALITATIVE ANALYSIS OF ARTIFICIAL NEURAL NETWORKS WITH IMPULSES[1]

Xinquan Zhao

Information School
Zhongnan University of Economics & Law
Wuhan, Hubei 430074, China

Abstract. In this article, we first give the existence conditions of a unique equilibrium of the Hopfield-type neural network with impulses; subsequently the sufficient conditions are given for the globally exponential stability; finally the instability of the equilibrium is studied. A new set of sufficient conditions for the existence, global exponential stability and instability of the unique equilibrium are derived.
Keywords. Hopfield-type network with impulses, unique equilibrium, global exponential stability, global asymptotical stability, instability.

1 Introduction

Artificial neural networks has become one of the most important technical tools for solving many problems in various scientific disciplines. From the mathematical point of view, an artificial neural network corresponds to a non-linear transformation of some inputs into certain outputs. Among many types of neural networks proposed and studied in the literature, the Hopfield-type network [1, 2], is becoming very important due to its potentiality for applications in associative memory, pattern recognition, optimization, model identification, signal processing, etc. The dynamical characteristics of the network are assumed to be governed by the dynamics of the following system,

$$C_i \frac{dx_i}{dt} = \sum_{j=1}^{n} T_{ij} f_i(x_i) - \frac{x_i}{R_i} + I_i, \quad i = 1, 2, \cdots, n. \tag{1.1}$$

where n denotes the number of neurons in the network; $x_i = x_i(t), i = 1, 2, \cdots, n$ denotes the average membrane potential of the i th neuron at time t ; $T_{ij}, i, j = 1, 2, \cdots, n$ denotes the matrix of numbers representing the synaptic connection strengths among the neurons; C_i denotes the capacitance in the i th sub-circuit; I_i denotes a constant external input current to the i th neuron; R_i denotes the resistance of the i th neuron; the functions

[1]This work is supported by National Natural Science Foundation of Chain under Grant 60474011, and Ministry of Education Special Foundation of Chain under Grant 97048722