Dynamics of Bidirectional Associative Memory Networks with Processing Delays

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Received: February 20, 2000; Revised: December 8, 2001

Abstract: A mathematical model describing the dynamical interactions of the bidirectional associative memory networks, incorporating among other things processing time delays, has been proposed in this paper. The existence and stability characteristics of the equilibrium patterns have been discussed. Results on local asymptotic stability of the equilibrium patterns have been presented. Three sets of easily verifiable sufficient conditions describing the global stability of the equilibrium patterns of these networks are obtained.

Keywords: Bidirectional associative memory networks; global stability.

Mathematics Subject Classification (2000): 34K20, 34K15, 92B20, 94CXX.

1 Introduction

Mathematical models describing the dynamical interactions of the bidirectional associative memory (BAM for short) networks have been a subject of numerous investigations, Kosko [14–16], Simpson ([23] and the references there in). In particular, the following BAM network model, known as Hopfield network is expressed by the following system of equations:

\[ x'_i(t) = -a_i x_i(t) + \sum_{j=1}^{n} b_{ij} f_j(x_j) + I_i, \]  

(1.1)

for \( i = 1, 2, \ldots, n \) (see, e.g. [11,12,16]). As may be seen this model describes the activation dynamics among the various neurons in one single neuronal field. In (1.1), \( a_i \) for \( i = 1, 2, \ldots, n \) represent the passive decay rates, \( b_{ij} \) denotes the synaptic connection weights between \( i \)-th and \( j \)-th neurons, \( f_j(x_j) \), for \( j = 1, 2, \ldots, n \) denote signal...