Stability Conditions for Nonlinear Continuous Random Neural Networks

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ABSTRACT

In this paper nonlinear continuous random neural networks with asymmetric connection weights are considered. Some sufficient conditions for a given network to have a globally asymptotically stable equilibrium distribution for arbitrary input are derived. Finally, future research issues for these neural networks are briefly discussed.

The term neural network originally referred to a network of interconnected neurons. Today the neural network has come to mean any computing architecture that consists of massing parallel interconnection of simple "neural" processors. It is a network that performs some computational task (recognition, association, etc.) on a given pattern via interaction between a number of interconnected units having simple functions. Many types of neural networks are introduced and studied for various purposes since 1960, especially in the last decade. Recently, K. Matsuoka dealt with the following type of neural networks which he called as nonlinear continuous neural network with asymmetric connection weights. The dynamics of the network is represented by

$$\begin{cases} \tau \frac{dx_i(t)}{dt} = -x_i(t) + \sum_j \bar{w}_{ij} y_j(t) + s_i \\ y_i(t) = g_i(x_i(t)) \end{cases} \quad (1)$$

where $x_i(t)$ is the variable that represents a state of unit neuron i at time t ($i = 1, 2, \dots, N$). s_i a constant input from the outside of the network, and $y_i(t)$ an output at time t . $\bar{w}_{ij}$ is the strength of connection from unit j to unit i , τ is a time constant governing the rate of change of each unit's state. He obtained some stability conditions for these neural networks. In this paper, we consider the stable problem for system (1) with white noise i.e. We deal with the following type of neural networks, which dynamics is represented by

$$\begin{cases} \tau \frac{dx_i(t)}{dt} = -x_i(t) + \sum_j \bar{w}_{ij} y_j(t) + s_i + \sum_j c_{ij} dB_j(t) \\ y_i(t) = g_i(x_i(t)) \end{cases} \quad (2)$$

where $B_j(t)$, $1 \leq j \leq m$ are independent white noise, and $(c_{ij})_{1 \leq i \leq N, 1 \leq j \leq m}$ is constant matrix. We called system (2) as nonlinear continuous random neural networks with asymmetric connection weights. Some stability conditions are obtained for these neural networks in this paper. In particular, when $(c_{ij}) = 0$, our results are same as K. Matsuoka's.