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GLOBAL DYNAMICS OF PERIODIC DELAYED NEURAL NETWORKS MODELS

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Abstract. In this paper, without assuming the smoothness, monotonicity and boundedness of the activation functions, some new and simple sufficient conditions of the existence and global exponential stability of periodic attractors for a model of periodic delayed recurrent neural networks are obtained by utilizing topological degree theory and the Lyapunov functional methods, which are natural extension and generalization of the corresponding results existing in the literature.

Keywords. Periodic delayed recurrent neural networks, dynamic attractor, periodic solutions, stability, topological degree theory, Lyapunov functional.

AMS (MOS) subject classification: 34C27, 34D23, 39A12, 92B20, 65D30.

1 Introduction

There has recently been increasing interest in applications of the dynamical properties of delayed neural networks (DNNs) such as delayed Hopfied neural networks [1] and delayed cellular neural networks [2] in signal processing, pattern recognition, optimization and associative memories, and pattern classification. It is well-known that the models of DNNs are described by a set of differential equations with delays in the following form:

$$\dot{x}_i(t) = -c_i x_i(t) + \sum_{j=1}^{n} a_{ij}^0 f_j(x_j(t)) + \sum_{j=1}^{n} a_{ij}^\tau f_j(x_j(t-\tau_{ij})) + u_i, \;\; i = 1, \cdots, n. \tag{1}$$

or

$$\dot{x}(t) = -Cx(t) + Af(x(t)) + A^\tau f(x(t-\tau)) + u, \tag{1$'$}$$

where $x(t) = (x_1(t), \cdots, x_n(t))^\top$ is the state vector of the neural network, $C = \mathrm{diag}(c_1, \ldots, c_n)$ is a diagonal matrix with $c_i > 0\,(i = 1, \cdots, n)$, $A = (a_{ij}^0)_{n\times n}$ is a weight matrix, $A^\tau = (a_{ij}^\tau)_{n\times n}$ is the delayed weight matrix,