Dynamics of Continuous, Discrete and Impulsive Systems
Series **A:** *Mathematical Analysis* **17 (2010)** 145-155
 http://www.watam.org

GLOBAL ASYMPTOTIC STABILITY OF A CLASS OF NONLINEAR FUNCTIONAL DIFFERENTIAL EQUATIONS WITH UNBOUNDED DELAYS

Manchun Tan

Department of Mathematics, Jinan University, Guangzhou, 510632, China
email: tanmc@jnu.edu.cn

Abstract. In the paper, a class of nonlinear differential equations involving unbounded time delays is studied. New sufficient conditions for asymptotic stability are derived by means of a Marachkov-type criterion. The new results extend and improve some known results about pantograph equation and neural networks in the literature. Two illustrative examples are given to show the effectiveness of the new results.

Keywords. nonlinear time-delay system; existence and uniqueness of equilibrium point; global asymptotic stability; functional differential equation.

AMS (MOS) subject classification: 34K20 92B20

1 Introduction

In this paper, we consider the nonlinear system described by the following functional differential equations (FDEs) with multiple time-varying delays:

$$\dot{x}_i(t) = \alpha_i(x_i(t))[-\beta_i(x_i(t)) + \sum_{j=1}^{n} a_{ij} f_j(x_j(t)) + \sum_{j=1}^{n} b_{ij} g_j(x_j(t-\tau_{ij}(t))) + u_i], \tag{1}$$

where $i = 1, 2, \cdots, n$, $x_i(t)$ is the state variable, $\alpha_i, \beta_i, f_i, g_i$ are appropriately functions, a_{ij} and b_{ij} are constants, u_i is the external input, and $\tau_{ij}(t) \geq 0$ is the time-varying delay.

System (1) possesses wide applications in applied mathematics and engineering. A simple case of (1) is the pantograph equation $\dot{x}(t) = ax(t)+bx(qt)$, which is relevant to the study of pantograph head of an electric locomotive (see [1],[2] and references therein). System (1) could also include the well-known neural networks (Hopfield neural network, bidirectional associative memory network, Cohen-Grossberg neural network etc.) as its special cases [3]-[8]. During the last decades, there are a large number of studies on time-delayed system. Most of the authors obtained some sufficient conditions for the existence and stability of an equilibrium point for system (1) with