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# GLOBAL STABILIZATION FOR A CLASS OF HIGH-ORDER TIME-DELAY NONLINEAR SYSTEMS

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Abstract. *This paper addresses the stabilization for a class of high-order time-delay nonlinear systems. Under some essential restriction on the system growth, by the method of adding a power integrator, a continuous state-feedback controller is successfully designed, and the global asymptotic stability of the resulting closed-loop system is proven with the help of an appropriate Lyapunov-Krasovskii functional. A numerical example is also provided to illustrate the effectiveness of the theoretical results.*
**Keywords:** High-order time-delay nonlinear systems, Adding a power integrator, Stabilization, Lyapunov-Krasovskii functional

1. **Introduction.** Over the past decades, significant progress has been made on control design and stability analysis for time-delay linear systems (see e.g., [2,3,6] and references therein). However, for the time-delay nonlinear systems, there exist many open problems which are so important and interesting at least from the theoretical point of view and have been payed careful attention, see for example the lastly published papers [5,7-16]. Specifically, by backstepping method, [8] constructed the output feedback controller (independent of time-delay) and [10] presented a continuously differentiable state-feedback control design based on a Lyapunov-Krasovskii functional, both for time-delay nonlinear systems. In the presence of unknown uncertainties, merged with wavelet neural network, a time-delay independent adaptive controller is obtained in [5] for a class of time-delay nonlinear systems with triangular structure, and further research can be seen in [9].

In this paper, we consider a class of high-order time-delay nonlinear systems in the following form:

$$\begin{cases} \dot{x}_i(t) = x_{i+1}^{p_i}(t) + f_i(x_{[i]}(t),\, x_{[i]}(t-\tau)), \ i = 1, \ldots, n-1, \\ \dot{x}_n(t) = u^{p_n}(t) + f_n(x(t),\, x(t-\tau)), \end{cases} \tag{1}$$

where $x = [x_1, \ldots, x_n]^\top \in \mathbb{R}^n$ is the system state vector, and $x_{[i]} = [x_1, \ldots, x_i]^\top \in \mathbb{R}^i$; $u \in \mathbb{R}$ is the control input; $\tau \in \mathbb{R}^+$ is the time-delay of the state; the system initial condition is $x(\theta) = \xi_0(\theta)$, $\theta \in [-\tau, 0]$, $\xi_0$ being specified continuous initial function; $p_i \in \mathbb{R}^{\geq 1}_{\mathrm{odd}} := \left\{ \frac{p}{q} \,|\, p \text{ and } q \text{ are positive integers, and } p \geq q \right\}$; $f_i$, $i = 1, \ldots, n$ are unknown continuous functions satisfying $f_i(0, 0) = 0$, $i = 1, \ldots, n$.