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OUTPUT REGULATION FOR A CLASS OF NONLINEAR SYSTEMS USING THE OBSERVER BASED OUTPUT FEEDBACK CONTROL

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Abstract. In this paper we study the global robust output regulation problem for a class of nonlinear systems by output feedback control. The class of systems is more general than systems studied in the literature. As an illustration of our approach, we have applied our approach to the global robust asymptotic tracking problem of the well known hyperchaotic Lorenz system.

Keywords. Nonlinear systems; output feedback systems; output regulation; output feedback control; robust control.

1 Introduction

In this paper, we consider the global robust output regulation problem for the uncertain nonlinear systems which can be transformed into the following form

$$\begin{aligned}
\dot{z} &= f(z, y, v, w) \\
\dot{x}_i &= x_{i+1} + g_i(z, y, v, w),\ i = 1, \cdots, r-1 \\
\dot{x}_r &= bu + g_r(z, y, v, w) \\
y &= x_1 \\
e &= x_1 - q(v, w)
\end{aligned} \tag{1}$$

where $(z, x) \in \mathbb{R}^n \times \mathbb{R}^r$ with $r \geq 2$ is the state, $u \in \mathbb{R}$ is the input, $y \in \mathbb{R}$ is the output, b is a nonzero constant with an unknown sign, $w \in \mathbb{W} \subset \mathbb{R}^{n_w}$ is an uncertain parameter vector with $\mathbb{W}$ a prescribed subset of $\mathbb{R}^{n_w}$, and $v(t) \in \mathbb{R}^{n_v}$ is an exogenous signal representing both reference input and disturbance. It is assumed that $v(t)$ is generated by a linear system of the following form

$$\dot{v} = A_1 v, \quad v(0) = v_0 \tag{2}$$

where all the eigenvalues of matrix A_1 are simple with zero real parts. All functions in (1) are supposed to be globally defined, sufficiently smooth, and satisfy $f(0, 0, 0, w) = 0$, $g_i(0, 0, 0, w) = 0$, and $q(0, w) = 0$ for all $w \in \mathbb{W}$.