Antoniades, Charalambos; **Christofides, Panagiotis D.**
Robust control of nonlinear time-delay systems. (English) Zbl 0952.93042
Int. J. Appl. Math. Comput. Sci. 9, No. 4, 811-837 (1999).

The paper is devoted to the robust control problem of the single-input single-output nonlinear system

$$\dot{x} = f(x(t), x(t-\alpha), \theta(t-\alpha_\theta)) + g(x(t), x(t-\alpha))u(t),$$
$$y(t) = h(x(t)),$$

where $x(t) \in \mathbb{R}^n$ denotes the vector of the state variables, $u(t) \in \mathbb{R}$ is the input, $\theta(t-\alpha_\theta) \in \mathbb{R}^q$ is the vector of the uncertain variables, $y(t) \in \mathbb{R}$ is the controlled output, f, g, h are locally Lipschitz nonlinear functions, $f(0,0,0) = 0$.

The authors address the problem of synthesizing nonlinear static state feedback control laws of the form $u(t) = R(x(t), \bar{v}(t), x(t-\alpha), \bar{v}(t-\alpha))$, where R is a nonlinear scalar function, $\bar{v}(s) = [v(s), v^{(1)}(s), \ldots, v^{(r-1)}(s)]^T$, $s \in [t-\alpha, t]$, $v^{(k)}$ is the k-th derivative of the reference input $v \in \mathbb{R}$. A general methodology is developed for the synthesis of robust controllers that guarantee boundedness of the states and ensure that the ultimate discrepancy between the output and the reference output in the closed-loop system can be made arbitrarily small by a choice of controlled parameters. The controllers enforce these properties independently of the size of the state delay.

A novel combination of geometric technique and the method of Lyapunov functionals is used. The proposed methodology is applied to a model of a fluidized catalytic cracking unit.

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MSC:

93B51	Design techniques (robust design, computer-aided design, etc.)
93C23	Control/observation systems governed by functional-differential equations
93C10	Nonlinear systems in control theory
93C95	Application models in control theory
93D30	Lyapunov and storage functions
93B52	Feedback control

Keywords:

model uncertainty; time-delays; nonlinear robust control; fluidized catalytic cracker