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GLOBALLY UNIFORMLY ASYMPTOTICAL STABILIZATION OF TIME-DELAY NONLINEAR SYSTEMS

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Abstract. Based on backstepping approach, the problem of globally uniformly asymptotically stabilizing time-delay nonlinear systems is proposed. The design strategy depends on the construction of a Lyapunov-krasovskii functional. A continuously differentiable control law is given. The simulation shows the effectiveness of the method.

Keywords. time-delay, control, Lyapunov function, nonlinear systems, stabilization.

AMS (MOS) subject classification: nonlinear systems, stabilization

1 Introduction

One of the most popular nonlinear techniques of control design is the backstepping approach. The purpose of backstepping is the construction of various types of control Lyapunov functions : robust, Input-to-state stability (ISS), etc. Backstepping constructions of robust control Lyapunov function were presented by Freeman et al.[1], Marino et al.[2], and Cai et al.[3-4]. Backstepping also serves for ISS-control Lyapunov function construction in Krstic et al.[5]. The multiple advantages offered by this approach are well-known. Zhang et al.[6] used the backstepping approach to design a control law for linear time-varying systems with known and unknown parameters. For systems with stochastic disturbance backstepping designs were developed by Krstic et al.[7]. Backstepping was employed to solve an almost disturbance decoupling problem by Isidori [8], and Ding [9]. Freeman et al.[10] extended backstepping to control inputs with magnitude and rate limits. It is observed in particular that this technique yields a wide family of globally asymptotically stabilizing control laws, allows to address robustness issues and to solve adaptive problems. Mazenc et al. [11] based on backstepping approach, solved the problem of designing feedbacks bounded in norm. Mazenc et al.[12] worked out the problem of stabilizing chains of integrators with bounded controls when there is a delay arbitrarily large in the input. The interconnection of nonlinear systems with delay was studied in Michiels et al. [13]. Basin et al.[14] solved the optimal filtering problem for a linear system over observations with multiple delays. The optimal controller for