Adaptive Output Control of a Class of Time-Varying Uncertain Nonlinear Systems

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Abstract: In this paper, we present a new scheme to design adaptive controllers for single-input single-output uncertain time-varying systems in the presence of unknown bounded disturbances. No knowledge is assumed on the sign of the term multiplying the control. The control design is achieved by introducing certain well defined functions, estimating variation rates of parameters and incorporating a Nussbaum gain. To overcome the problem of overparametrization, tuning functions, which are different from the standard ones due to the use of projection operations, are employed. It is shown that the proposed controller can guarantee global uniform ultimate boundedness.

Keywords: Adaptive control; backstepping; time-varying systems; tuning functions; Nussbaum gain.

Mathematics Subject Classification (2000): 93C40.

1 Introduction

Adaptive control has seen significant development since the appearance of a Lyapunov-based recursive design procedure known as backstepping [7]. A great deal of attention has been paid to tackle both linear and nonlinear systems with unknown parameters and a number of results have been obtained in [1–6]. However, only limited number of results are available for nonlinear systems with time-varying parameters and/or without the knowledge on the sign of the term multiplying the control, i.e. high frequency gain in the case of linear systems, in the presence of external disturbances. In this paper, we shall also call this term the high frequency gain for nonlinear systems for simplicity.

In [9], output feedback control was considered for linear time-varying systems when the sign of high-frequency gain is known. In [11], the problem of adaptive control with

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