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STABILITY ANALYSIS OF PIECEWISE LINEAR SYSTEMS WITH DISCRETE AND DISTRIBUTED TIME DELAYS

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Abstract. This paper is concerned with the stability analysis problem for a class of piecewise linear systems with both discrete and distributed time delays. A *piecewise* Lyapunov-Krasovskii functional is constructed so as to derive sufficient conditions for the globally asymptotic stability of the piecewise linear systems with discrete and distributed time-delays. The derived stability criteria are expressed in terms of linear matrix inequalities (LMIs), which can be readily checked by using the standard Matlab LMI Toolbox. A numerical example is used to demonstrate the usefulness of the methods.

Keywords. Piecewise linear systems, discrete and distributed delay, linear matrix inequality (LMI), stability.

AMS (MOS) subject classification: 34K20.

1 Introduction

Piecewise-linear systems (PLS) are characterized by a finite number of linear dynamical models together with a set of rules for switching among these models. The discontinuity actions, such as dead zone, saturation, relays, and hysteresis, are naturally reflected in the dynamics of the PLS from either the controller or system nonlinearities. Also, many other classes of nonlinear systems can be simply approximated by the PLS. Therefore, PLS are commonly employed as models for practical system analysis and control.

Although widely used and intuitively simple, PLS are computationally hard and only recently there have been some interesting results on analysis and controller design (see [1]-[3], [5]-[11] and the references therein). For example, in [7], a uniform and computationally tractable approach has been developed for stability analysis of piecewise affine systems. There, instead of using the globally quadratic Lyapunov functions, *piecewise* quadratic Lyapunov functions have been searched by means of linear matrix inequalities

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