IMPROVED PARAMETER-DEPENDENT ROBUST STABILITY CRITERIA FOR TIME-DELAY SYSTEMS WITH POLYTOPIC UNCERTAINTIES

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ABSTRACT. *This paper considers the problem of parameter-dependent and delay-dependent robust stability for time-delay systems with polytopic uncertainties. By constructing a new parameter-dependent Lyapunoy functional and applying free-weighting matrices technique, the new parameter-dependent and delay-dependent robust stability conditions will be obtained in terms of linear matrix inequalities (LMIs). Finally, numerical examples are provided to illustrate the effectiveness and the merits of the proposed method.*
Keywords: Parameter-dependent, Time-delay systems, Robust stability, LMIs

1. **Introduction.** Dynamic systems often encounter the effects of delays in the processing state, input or related variables. In recent years, the stability analysis and controller synthesis for systems with time-delay are important both in theory and practice [1-4]. Existing criteria for asymptotic stability of time-delay systems can be classified into two categories: delay-independent criteria and delay -dependent criteria. It is well known that delay-dependent criteria make use of information on the length of delays, they are less conservative than delay-independent ones, especially when the time delays are small. Therefore, increasing attention has been paid on delay-dependent stability conditions [5-15]. Recently, free-weighting matrices method or slack-variable method was developed in [11-13] and [14] and the reference therein.

On the other hand, a wide class of uncertainty types studied in the systems and control literature fall into the polytopic perturbations. In recent years, there is increasing interesting in the stability analysis for systems with polytopic uncertainties [12,16-18]. For time-delay systems with polytopic-type uncertainties, one hopes to develop the parameter-dependent stability conditions to overcome the conservatism arisen from the use of a single Lyapunov matrix in quadratic stability method. It has been shown that the parameter-dependent stability condition is of less conservativeness than quadratic stability condition which requires a common Lyapunov function for the entire uncertain domain [12,16-18]. By introducing one or more slack matrix variable, the problems of delay-dependent and parameter dependent stability for systems with polytopic uncertainties and time-delay were studied in [12,16-18].

Motivated by the above observation, in this article, an improved parameter- dependent and delay-dependent stability condition for time-delay systems with polytopic uncertainties will be obtained. By using free-weighting matrices method and the Lyapunov stability