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FUZZY H_∞ FILTER DESIGN FOR NONLINEAR DISCRETE-TIME SYSTEMS WITH TIME-VARYING DELAYS

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Abstract. *This paper deals with the problem of H_∞ filter design for nonlinear discrete-time systems with time-varying delays via T-S fuzzy model approach. Some delay-dependent conditions for fuzzy H_∞ filter are proposed in terms of linear matrix inequalities(LMIs), which produce a less conservative result. Finally, one numerical example is given to demonstrate the effectiveness and the benefits of the proposed method.*
Keywords: Discrete-time, H_∞ filtering, Fuzzy systems, Linear matrix inequality (LMI)

1. **Introduction.** During the last decades, H_∞ filtering has attracted the attention of many researchers, especially in the fields of signal processing and control communities[22]. Some H_∞ filter design approaches were proposed for linear systems, see [4, 5, 7, 15] and references therein. As T-S fuzzy model [18] has become a popular and effective approach in investigating complex and ill-defined systems for which the application of conventional techniques is infeasible[1, 2, 8, 11, 19, 20], in recent years, T-S fuzzy model approach has been extended to H_∞ filter design [12, 13, 23]. For continuous-time T-S fuzzy systems, a delay-independent LMI approach is proposed for exponential H_∞ filter design for T-S fuzzy delayed systems. The work in [13] is concerned with H_∞ filtering of nonlinear systems with time-varying delays via T-S fuzzy model approach.

For discrete-time T-S fuzzy systems, several H_∞ filtering approaches for delay-free systems were proposed in [21, 26]. Since time delay often appears in practical systems, and it is frequently the source of instability and degraded performance, the study of time-delay systems is of both theoretical and practical importance. It turns out that the noise attenuation level guaranteed by an H_∞ filter design without considering non-negligible time delays[21, 26] may be invalid in the presence of time-delays. Therefore, considerable attention has been paid to the H_∞ filter design for T-S fuzzy delayed systems. Generally, the obtained results on delayed systems can be classified into two types: delay-independent ones[14, 25] and delay-dependent ones[3, 17]. It is shown that the latter is generally less conservative since the size of delays is considered, especially when the size of delays is small. Based on a novel piecewise Lyapunov-Krasovskii functional, both the delay-dependent full-order and reduced-order H_∞ filter design approaches are proposed in [3]. Authors in [17] have discussed the problem of delay-dependent robust H_∞ filtering for