

A DESCRIPTOR SYSTEM APPROACH TO $l_2 - l_\infty$ FILTERING FOR UNCERTAIN DISCRETE-TIME SWITCHED SYSTEM WITH MODE-DEPENDENT TIME-VARYING DELAYS

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ABSTRACT. *The problem of $l_2 - l_\infty$ filtering for uncertain discrete-time switched systems with mode-dependent time-varying delays is investigated in this paper. The switched system under consideration is subject to time-varying norm-bounded parameter uncertainties in both the state, measured output matrices and estimated signal. Attention is focused on the design of a filter, which guarantees the asymptotical stability of the filtering error system and reduces the effect of the disturbance input on the filtering error system to a prescribed level for all admissible uncertainties. By resorting to a descriptor system approach, some delay-dependent sufficient conditions are presented in terms of linear matrix inequalities (LMIs). A numerical example is provided to demonstrate the effectiveness of the proposed algorithms.*

Keywords: Discrete-time switched systems, Mode-dependent time-varying delays, Linear matrix inequality (LMI), $l_2 - l_\infty$ filtering, Uncertain systems

1. Introduction. By a switched system, we mean a hybrid dynamical system that is composed of a family of continuous-time or discrete-time subsystems and a rule orchestrating the switching among the subsystems. Recently, the stability analysis and performance index synthesis issue of switched systems has been extensively investigated and many results and methodologies have been established [1, 2, 3, 4, 5, 6, 7]. For example, multiple Lyapunov functions approach was proposed in [1] to obtain certain general stability conditions for nonlinear switched systems, where an individual decrescent Lyapunov function was constructed for each subsystem. An average dwell time approach was first employed to study the stability of switched systems in [5], where the “slow switching” idea was proposed.

Uncertainties and time-delays are the inherent features of many physical processes, which may degrade system performance and cause oscillation, leading to instability. Recently, there are growing interests in the stabilization and performance index analysis of the systems with delays [8, 9, 10, 11, 12, 13]. For uncertain discrete-time switched systems with time delays, the robust H_∞ filtering results were given in [8]. [9] solved the tracking problem for a class of uncertain switched systems with time-varying delay using a strategy of model reference adaptive integral sliding mode variable structure control. In [10], authors presented sufficient conditions of stability and weighted L_2 -gain for switched systems with time-varying delays.

The topic of filtering for systems has been widely investigated in the past decades since the filtering is one of the most popular approaches to deal with external noise in systems. Kalman filtering was first proposed in [14]. $l_2 - l_\infty$ performance index was