Reachable Set Bounding for Some Classes of Perturbed Positive Time-Delay Systems

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Abstract: Disturbances are usually unavoidable in engineering and control systems due to modeling inaccuracies, linearization approximations, external noises, measurement errors and data transformation. In the presence of the unknown disturbance vector, in general, one can not find exactly the trajectories of the system. However, under the assumption that the disturbance vector is bounded by a known-bound, the problem of finding a smallest possible set, which is called a reachable set, of all the states that are reachable from a given set has been significant and plays an important role in many practical applications such as safety verification, model checking, etc.

Time delay is also unavoidable in practical control systems and topic of stability analysis of time-delay systems has received extensive attention in past decades. In 2003, Fridman and U. Shaked, for the first time, have extended the problem of reachable set bounding to linear time-delay systems. In recent years, many significant developments, which used the Lyapunov method combining with linear matrix inequality techniques, of this problem have been reported. In 2007, H. Haimovich, E. Kofman and M.Seron proposed another approach, which is based on the comparison method combining with positive matrices and does not use the Lyapunov method to the problem of reachable set bounding of a class of linear positive time-delay systems.

In this talk, we present some recent our developments on the problem of finding state bounds of positive time-delay systems perturbed by unknown-but-bounded disturbances. We consider the problem of finding minimized bounds of the state vector in two cases: (i) when the time tends to a pre-specified value; and (ii) when the time tends to infinity. Based on the comparison method, positive matrices combining with some optimization techniques, we derive minimized bounds of the state vector for two cases. An application of the obtained results to analyze the stability of a class of nonlinear time-delay systems is presented.

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