

Parametric Lyapunov Equation based Event-Triggered Control

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Traditional periodic sampling control methods need to constantly update the control signal, which often causes unnecessary energy consumption and excessive use of actuators. In contrast, event-triggered control (ETC) method updates the control signal through a pre-designed event-triggered condition, that is, the control signal is only updated when the system state satisfies a certain condition. Hence, this mechanism will greatly save the energy of the system and reduce the action of the actuator. In addition, due to the massive use of network control systems with limited communication resources in modern industry, this makes ETC algorithms that can greatly save communication resources have greater development potential. It should be emphasized that although the ETC algorithms can save communication resources and energy, it often reduces control performance. How to make a trade-off between improving control performance and saving communication resources has very important theoretical and engineering significance.

Based on the parametric Lyapunov equation (PLE) and using its unique properties, especially scalar characteristics, we have conducted a series of studies on the event-triggered control problem of the input constrained system and have designed some ETC algorithms. The proposed ETC algorithms can not only give the minimum inter-execution time (MIET) as a decreasing function of the parameter in PLE, but also give the explicit relationship between MIET, control performance (convergence rate) and the parameters of PLE. In addition, the use of the special properties of PLE, especially the scalar properties, significantly simplifies the analysis of Zeno behavior, and reduces the conservativeness of MIET, and avoids the complex relationship between MIET and the system matrices. Due to the scalar characteristics of PLE, the designed ETC method has great compatibility and scalability, that is, under the premise of maintaining the advantages of the original ETC algorithm, it can be easily combined with other control algorithms, such as dynamic event-triggered control algorithm, gain scheduling method and adaptive control method.

Keywords: actuator saturation; event-triggered control; parametric Lyapunov equation.