Leader-following consensus of multi-agent systems with input constraints by distributed dynamic event-triggered strategy under switching topologies

Meilin Li
School of Automation Engineering
University of Electronic Science and Technology of China
Chengdu, China
meilinli0126@163.com

Tieshan Li
School of Automation Engineering
University of Electronic Science and Technology of China
Chengdu, China
tieshanli@126.com

Yue Long
School of Automation Engineering
University of Electronic Science and Technology of China
Chengdu, China
longyue@uestc.edu.cn

***Abstract*—In practical control systems, almost all the control actuation devices are inevitably bound by limitations in their operational amplitudes. Note that, the limitations of actuators are termed input constraints, which have recently drawn attention in the context of leader-following consensus control problems in multi-agent systems. For most leader-following consensus control problems of the multi-agent systems, each agent needs to measure its own state, send the state to its neighbors, and update its control signal continuously or in a prescribed sampling frequency which need to consume more energy and communication resources and more complicated to control compared with the single-agent system. Therefore, new control schemes need to be designed such that the communication load and controller update for each agent can be reduced significantly with the bounded control protocol. In this way, the limited energy resources of agents can be greatly saved and the service life of multi-agent systems can be prolonged. To address this issue, this paper studies the leader-following consensus control problem of multi-agent systems with input constraints based on the distributed static and dynamic event-triggered control (ETC) under switching topologies in which all the agents have an identical linear dynamic mode. First, a novel distributed low-gain static ETC algorithm based on the parametric Lyapunov equation (PLE) is proposed. Then the corresponding distributed low-gain dynamic ETC is also proposed. In the designed distributed static and dynamic ETC algorithms, the update of triggering times and the controller of any agent are independent of triggering time instants of all other agents which reduce both the amount of communication and the update frequency of the controllers in practice. Meanwhile, a functional relationship between the minimum inter-execution time (MIET) and the only adjustable parameter in PLE is established in the designed static and dynamic ETC algorithms, which allows us to easily find a trade-off between the inter-execution times (IET) and the control performance. The fact that the MIET of the dynamic ETC is never less than that of the static ETC is also guaranteed. Theoretical analysis indicates that the leader-following consensus is achieved with a global exponential convergence rate. Moreover, the average dwell time method is adopted to relax restrictions on the switching speed of topological structures and an original analytical thought is put forward to rule out the Zeno phenomenon concisely and clearly. Finally, the numerical simulations of the control system show the effectiveness of the proposed algorithms.**

***Index Terms*—Event-triggered control, low-gain feedback, parametric Lyapunov equation, multi-agent system, switching topologies, input constraints.**

This work is supported in part by the National Natural Science Foundation of China under Grants 51939001, 62273072, 62203088, the Natural Science Foundation of Sichuan Province under Grant 2022NSFSC0903.