Comments and Corrections

Errata: Distributed Event-Triggered Adaptive Control for Cooperative Output Regulation of Heterogeneous Multi-Agent Systems Under Switching Topology

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***Abstract*—This article aims to point out an error in the concerned paper and a possible correction to address the error. The correction is achieved by several revisions made on the corresponding assumption, event-triggering function, adaptive laws, and event-triggered control law.**

***Index Terms*—Adaptive control, cooperative output regulation, event-triggered control, heterogeneous multi-agent systems, switching topology.**

I. Corrigendum

There exists an error in the proof of [1, Th. 1], that also affects Theorem 2. The error happens in the paragraph after [1, eq. (21)]. In fact, the claim "there exist $\nu_1 \geq 1$ and $\nu_2 \geq 1$ such that $\nu_1 d_i(t) \geq d_{\max}(t)$ and $\nu_2 N^3 \rho_i(t) \geq \rho_{\max}(t)$" is incorrect. The claim holds only when $d_i(t)$ and $\rho_i(t)$ are bounded.

To address this error, the following several revisions need to be done.

1) Assumption 1 in [1] needs to be revised as follows.

Assumption 1: Node 0 is globally reachable in each possible graph $\mathcal{G}^{\sigma(t)}$, and the communication topologies among nodes i, $i = 1, \cdots, N$ are undirected.

Remark 1: Although the communication topologies among nodes i, $i = 1, \cdots, N$ are strengthen to be undirected, compared with existing works [2], [3] on fully distributed event-triggered control, in which the communication topology is fixed and undirected, the switching communication graph considered in this errata can still cover most of them as special cases.

2) The second equation in [1, eq. (7)] and the third equation in [1, eq. (34)] should be replaced by

$$\dot{\eta}_i(t) = S\eta_i(t) + \sum_{j=1}^{N} a_{ij}^{\sigma(t)} d_{ij}(t)\hat{z}_{ij}(t) + a_{i0}^{\sigma(t)} d_{i0}(t)\hat{z}_{i0}(t) \tag{C1}$$

where $\hat{z}_{ij}(t) = e^{S(t-t_{k'}^j)}\eta_j(t_{k'}^j) - e^{S(t-t_k^i)}\eta_i(t_k^i)$ and $\hat{z}_{i0}(t) = e^{S(t-t_k^i)}v(t_k^i) - e^{S(t-t_k^i)}\eta_i(t_k^i)$.

3) The third equation in [1, eq. (7)] and the fourth equation in [1, eq. (34)] should be replaced by

$$\begin{aligned} \dot{d}_{ij}(t) &= \gamma_{ij} a_{ij}^{\sigma(t)} \hat{z}_{ij}^\top(t)\hat{z}_{ij}(t) \\ \dot{d}_{i0}(t) &= \gamma_{i0} a_{i0}^{\sigma(t)} \hat{z}_{i0}^\top(t)\hat{z}_{i0}(t) \end{aligned} \tag{C2}$$

where $\gamma_{ij} > 0$, $\gamma_{i0} > 0$, $d_{ij}(0) \geq 1$, and $d_{i0}(0) \geq 1$.

4) Reference [1, eq. (9)] should be replaced by

$$\begin{aligned} f_i(t) &= \omega_i(t)\bar{d}_i(t)\eta_{ei}^\top(t)\eta_{ei}(t) - \hat{z}_i^\top(t)\hat{z}_i(t) - \alpha_{1i}e^{-\alpha_{2i}t} \\ \dot{\omega}_i(t) &= \beta_i \bar{d}_i(t)\eta_{ei}^\top(t)\eta_{ei}(t) \end{aligned}$$

where $\bar{d}_i(t) = \sum_{j=1}^N a_{ij}^{\sigma(t)} d_{ij}(t) + a_{i0}^{\sigma(t)} d_{i0}(t)$, $\hat{z}_i(t) = \sum_{j=1}^N a_{ij}^{\sigma(t)} \hat{z}_{ij}(t) + a_{i0}^{\sigma(t)}\hat{z}_{i0}(t)$, $\alpha_{1i} > 0$, $\alpha_{2i} > 0$, $\beta_i > 0$ and $\omega_i(0) \geq 1$.

5) The second equation in [1, eqs. (10) and (35)] should be replaced by (C1).

With the above-mentioned revisions, the revised theorems are given as follows.

Theorem 1: Suppose that Assumptions 1–3 and 5 hold. Consider the multi-agent system (2) and the exosystem (3). Choose $\gamma_{ij} > 0$, $\gamma_{i0} > 0$, $\beta_i > 0$, $\alpha_{1i} > 0$, and $\alpha_{2i} > 0$, $i, j = 1, \cdots, N$. Let K_{1i}, $i = 1, \cdots, N$ be any gain matrices such that $A_i + B_i K_{1i}$ is Hurwitz, and $K_{2i} = U_i - K_{1i}X_i$. Under the state-feedback controller (7) and the event-triggering mechanism (9), the cooperative output regulation problem is solved and Zeno-behavior is excluded.

Theorem 2: Suppose Assumptions 1–5 hold. Consider the multi-agent system (2) and the exosystem (3). Choose $\gamma_{ij} > 0$, $\gamma_{i0} > 0$, $\beta_i > 0$, $\alpha_{1i} > 0$, and $\alpha_{2i} > 0$, $i, j = 1, \cdots, N$. Let K_{1i} and $\bar{H}_i$, $i = 1, \cdots, N$ be any gain matrices such that $A_i + B_i K_{1i}$ and $A_i - \bar{H}_i C_{mi}$ are Hurwitz, $K_{2i} = U_i - K_{1i}X_i$. Under the output-feedback controller (34) and the event-triggering mechanism (9), the cooperative output regulation problem is solved and Zeno behavior is excluded.

In addition, since [1, Corollaries 1 and 2] are the special cases in [1, Ths. 1 and 2], respectively, they should be revised accordingly. The simulation example should also be revised accordingly. Due to the limited space, they are omitted here.

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