EVENT-TRIGGERED SLIDING MODE OBSERVER

A. Actuator Side Implementation

$$t_{k+1}^{y} = \inf \left\{ t > t_{k}^{y} : ||e_{y}(t)|| \ge \sigma_{a}\alpha_{a} \right\}, \quad k \in \mathbb{Z}_{\ge 0}$$

$$t_{0}^{y} = 0 \qquad e_{y}(t) = \begin{bmatrix} \widetilde{C}_{11} \left(z_{1}(t_{k}^{y}) - z_{1}(t) \right) \\ z_{2}(t_{k}^{y}) - z_{2}(t) \end{bmatrix}$$

Event-based sliding mode observer:

$$\dot{\hat{z}}_{1}(t) = \widetilde{A}_{11}\hat{z}_{1}(t) + \widetilde{A}_{12}\hat{z}_{2}(t) + L_{1}\widetilde{C}_{11}\left(z_{1}(t_{k}^{y}) - \hat{z}_{1}(t)\right)
+ \widetilde{A}_{12}\left(z_{2}(t_{k}^{y}) - \hat{z}_{2}(t)\right)
\dot{\hat{z}}_{2}(t) = \widetilde{A}_{21}\hat{z}_{1}(t) + \widetilde{A}_{22}z_{2}(t_{k}^{y}) + K \text{sign}\left(z_{2}(t_{k}^{y}) - \hat{z}_{2}(t)\right)
+ u(t)$$
(9)

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+ \widetilde{A}_{12}\left(z_{2}(t_{k}^{y}) - \hat{z}_{2}(t)\right)
\dot{\hat{z}}_{2}(t) = \widetilde{A}_{21}\hat{z}_{1}(t) + \widetilde{A}_{22}z_{2}(t_{k}^{y}) + K \text{sign}\left(z_{2}(t_{k}^{y}) - \hat{z}_{2}(t)\right)
+ u(t)$$
(9)

Let
$$e_1(t) = z_1(t_k^y) - z_1(t)$$
 and $e_2(t) = z_2(t_k^y) - z_2(t)$

$$\dot{\hat{z}}_{1}(t) = \widetilde{A}_{11}\hat{z}_{1}(t) + \widetilde{A}_{12}\hat{z}_{2}(t) + L_{1}\widetilde{C}_{11}\tilde{z}_{1}(t) + \widetilde{A}_{12}\tilde{z}_{2}(t)
+ L_{1}\widetilde{C}_{11}e_{1}(t) + \widetilde{A}_{12}e_{2}(t)
\dot{\hat{z}}_{2}(t) = \widetilde{A}_{21}\hat{z}_{1}(t) + \widetilde{A}_{22}z_{2}(t) + K \text{sign}\left(\tilde{z}_{2}(t) + e_{2}(t)\right)
+ u(t) + \widetilde{A}_{22}e_{2}(t).$$
(10)

$$\dot{z}_1 = \widetilde{A}_{11} z_1 + \widetilde{A}_{12} z_2 \tag{3a}$$

$$\dot{z}_2 = \widetilde{A}_{21}z_1 + \widetilde{A}_{22}z_2 + u + d$$
 (3b)

Dynamics of Estimation Error:

$$\begin{split} \dot{\tilde{z}}_1(t) &= \widetilde{A}_1 \tilde{z}_1(t) - \widetilde{L}_1 e_y(t) \\ \dot{\tilde{z}}_2(t) &= \widetilde{A}_{21} \tilde{z}_1(t) - \widetilde{A}_{22} e_2(t) - K \text{sign} \left(\tilde{z}_2(t) + e_2(t) \right) \\ &+ d(t) \end{split}$$