Asychronous Control for Markov Jump Lure's Systems With Control Saturation

***Abstract*—The abstract here.**

I. Introduction

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mds

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II. Preliminaries

Consider a discrete-time MJLS with both actuator and sensor saturations on a probability space $(\Omega, \mathcal{F}, \mathcal{P})$:

$$\begin{cases} x_{k+1} = A_{r(k)}x_k + F_{r(k)}\varphi(y_k) + B_{r(k)}sat(u_k) \\ \qquad + E^x_{r(k)}w_k, \quad y_k = C_{r(k)}x_k, \\ z_k = C^z_{r(k)}x_k + G^z_{r(k)}\varphi(y_k) + D^z_{r(k)}sat(u_k) + E^z_{r(k)}w_k \end{cases} \tag{1}$$

where $x_k \in \mathbb{R}^{n_x}, u_k \in \mathbb{R}^{n_u}, y_k \in \mathbb{R}^{n_y}, z_k \in \mathbb{R}^{n_z}$, and $w_k \in \mathbb{R}^{n_w}$ are respectively the state, the control input, the output related to the nonlinearity, the controlled output and the exogenous disturbance vector of the system (1) at the instant k. The saturation function $sat(\cdot)$ is defined as follows: for any $u \in \mathbb{R}^n_u$, $sat(u)_{(\ell)} = \mathrm{sign(u)}_{(\ell)} \min(\rho_{(\ell)}, |\mathrm{(u)}_{(\ell)}|), \forall \ell = 1, \ldots, \mathrm{n_u}\}$, where the vector $0 < \rho < \mathbb{R}^n_u$ is assumed to be given. $\{r(k), k \geq 0\}$ is a Markov chain taking values in a finite set $\mathcal{N} = \{1, 2, \ldots, N\}$ with mode TPs:

$$\Pr\{r(k+1) = j | r(k) = i\} = \pi_{ij} \tag{2}$$

where $\pi_{ij} \geq 0, \forall i, j \in \mathcal{N}$, and related transition probability matrix is given by $\Pi = \{\pi_{ij}\}$, the system matrices in (1) can be expressed as $A_i, F_i, B_i, E^x_i, C^z_i, G^z_i, D^z_i$ and E^z_i, which are real known constant matrices with appropriate dimensions.
In this paper, we consider the following controller:

$$u_k = K_{\sigma(k)}x_k + \Gamma_{\sigma(k)}\varphi(y_k) \tag{3}$$

where $K_{\sigma(k)}$ is a time-varing matrix standing for the controller gian matrix, and the parameter $\{\sigma(k), k \geq 0\}$ takes values in another pre-given positive intger set, which is marked as $\mathcal{M} = \{1, 2, \ldots, M\}$ subject to the pre-known conditional probability matrix $\Omega = \{\mu_{im}\}$, the probabilities of which are defined by

$$\Pr\{\sigma(k) = m | r(k) = i\} = \mu_{im}. \tag{4}$$

Where the conditional probability $\mu_{im} \geq 0, \forall i \in \mathcal{N}, m \in \mathcal{M}$, and $\sum_{m=1}^{M} \mu_{im} = 1$ for all $i \in \mathcal{N}$.

Assumption 1: For each mode $i \in \mathcal{N}, \varphi_i(\cdot) : \mathbb{R}^{n_y} \to \mathbb{R}^{n_y}$ satisfies the following conditions:
(1) $\varphi_i(0) = 0$ and
(2) exist N diagonal positive definite matrices $\Omega_i \in \mathbb{R}^{n_y \times n_y}$ such that $\forall y \in \mathbb{R}^{n_y}$ and $\forall \ell = 1, \ldots, n_y$,

$$\varphi_{i,(\ell)}(y)[\varphi_i(y) - \Omega_i y]_{(\ell)} \leq 0. \tag{5}$$

We say in this case that the N nonlinearities $\phi_i(\cdot)$ satisfy their own cone bounded sector conditions and to be decentralized. From (5) we have $\forall i \in \ell_N, \forall y \in \mathbb{R}^p$:

$$SC(i, x, \Lambda_i) = \varphi_i^{\mathrm{T}}(C_i x)\Lambda_i[\varphi_i(C_i x) - \Omega_i C_i x] \leq 0, \tag{6}$$

where Λ_i are any diagonal postive semidefinite matrices. Not thar matrices $\Omega_i \in \mathbb{R}^{n_y \times n_y}$ are defined by the designer and, thus, they are considered to be given. From the II ,we have

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References

[1] H. Kopka and P. W. Daly, *A Guide to LaTeX*, 3rd ed. Harlow, England: Addison-Wesley, 1999.