HAMMERSTEIN SYSTEM

$$u_k \to \boxed{\mu()} \to \boxed{\{\gamma_i\}_{i=0}^{\infty}} \to \otimes \xleftarrow{z_k} \to y_k$$

$$\mu(u) = \sum_{i=1}^{n} c_i f_i(u)$$

$$i > m, \ \gamma_i = 0$$

$E z_k = 0$

$\operatorname{var} z_k < \infty$

z_k, u_k - i.i.d.

PARAMETRIC KNOWLEDGE

* BASIS $f_1() \ldots f_n()$ — A PRIORI KNOWN
* ORDER OF FIR DYNAMICS $\gamma_0, \gamma_1, \ldots, \gamma_m$

NONP. KNOWLEDGE

$\{(u_k, y_k)\}_{k=1}^{N}$

OVERPARAMETRIZATION APPROACH.

$$y_k = \underbrace{\begin{bmatrix} \gamma_0 c_1 \\ \vdots \\ \gamma_0 c_n \\ \gamma_1 c_1 \\ \vdots \\ \gamma_1 c_n \\ \vdots \\ \gamma_m c_1 \\ \gamma_m c_n \end{bmatrix}^T}_{\theta} \cdot \underbrace{\begin{bmatrix} f_1(u_k) \\ \vdots \\ f_n(u_k) \\ \vdots \\ f_1(u_{k-m}) \\ f_n(u_{k-m}) \end{bmatrix}}_{\varphi_k} + z_k$$

$$y_k = \theta^T \varphi_k + z_k$$

$$\text{cont.} = \dim \theta = n \cdot (m+1)$$

$N \times \dim \theta$

$$\Phi_N = \begin{bmatrix} \varphi_1^T \\ \vdots \\ \varphi_N^T \end{bmatrix}$$

$$\hat{\theta} = (\Phi_N^T \Phi_N)^{-1} \Phi_N^T Y_N$$

$$\hat{\theta} \longrightarrow \hat{c}, \ \hat{\gamma}$$

$$c = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_n \end{bmatrix}, \quad \gamma = \begin{bmatrix} \gamma_0 \\ \gamma_1 \\ \vdots \\ \gamma_m \end{bmatrix}$$

DEF.

$$M = \gamma c^T = \begin{bmatrix} \gamma_0 \\ \gamma_1 \\ \vdots \\ \gamma_m \end{bmatrix} [c_1, c_2, \ldots, c_n] = \begin{bmatrix} \gamma_0 c_1, & \gamma_0 c_2 & \ldots & \gamma_0 c_n \\ \gamma_1 c_1, & \gamma_1 c_2, & \ldots, & \gamma_1 c_n \\ \vdots & & & \\ \gamma_m c_1, & \ldots & & \gamma_m c_n \end{bmatrix}$$

$\operatorname{rank}(M) = 1$

$\operatorname{SVD}(M)$