

DOCUMENT DE SOUMISSION

JIME 2020

10/12 JUIN 2020

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TITRE DE LA PRESENTATION

An optimal instrumental variable approach for continuous-time multiple input-single output fractional model identification

MOTS CLES

Système linéaire	<input checked="" type="checkbox"/>	Modèle temps discret	<input type="checkbox"/>
Système non-linéaire	<input type="checkbox"/>	Modèle temps continu	<input checked="" type="checkbox"/>
Systèmes en réseau	<input type="checkbox"/>	Représentation d'état	<input type="checkbox"/>
Système temps variant	<input type="checkbox"/>	Fonction de transfert	<input checked="" type="checkbox"/>
Système multivariable	<input checked="" type="checkbox"/>	Modèle avec EDP	<input type="checkbox"/>
Système commutant	<input type="checkbox"/>	Modèle de connaissance	<input type="checkbox"/>
Système hybride	<input type="checkbox"/>	Non linéarité par bloc	<input type="checkbox"/>
Séries temporelles	<input type="checkbox"/>	Modèle stochastique	<input type="checkbox"/>
Bruit bornée	<input type="checkbox"/>		
Design d'expérience	<input type="checkbox"/>	Identification en boucle ouverte	<input checked="" type="checkbox"/>
Analyse spectrale	<input type="checkbox"/>	Identification en boucle fermée	<input type="checkbox"/>
Sortie quantifiée	<input type="checkbox"/>	Diagnostic	<input type="checkbox"/>
Caractérisation d'incertitude	<input type="checkbox"/>	Régularisation	<input type="checkbox"/>
Identifiabilité	<input checked="" type="checkbox"/>	Validation de modèle	<input type="checkbox"/>
Identification pour la commande	<input type="checkbox"/>	Analyse algorithme d'identification	<input type="checkbox"/>
Identification temps réel	<input type="checkbox"/>	Déconvolution	<input type="checkbox"/>
Apprentissage – data mining	<input type="checkbox"/>	Identif par ensemble d'appartenance	<input type="checkbox"/>
Applications industrielles	<input type="checkbox"/>	Robotique	<input type="checkbox"/>
Aérospatial	<input type="checkbox"/>	Transports	<input type="checkbox"/>
Economie	<input type="checkbox"/>	Biologie/vivant	<input type="checkbox"/>
Automobile	<input type="checkbox"/>	Energie/développement durable	<input type="checkbox"/>
Logiciel	<input type="checkbox"/>	Enseignement de l'identification	<input checked="" type="checkbox"/>

Autres mots clés :

RESUME ETENDU (1 PAGE)

An instrumental variable approach for continuous-time MISO system identification using fractional models is proposed.

This work can be viewed either as an extension of the simplified refined instrumental variable for fractional models (srivcf) (Victor et al. (2013)) to the MISO case or an extension of the MISO-srvic (Garnier et al. 2007) to the fractional case. A fixed fractional differentiation order is first of all considered. When it is assumed to be unknown, a particular attention is given to its choice.

Assuming a MISO model with n_u inputs, described by:

$$\begin{cases} y_{u_k}(t) = G_k(p)u_k(t) \\ y(t) = \sum_{k=1}^{n_u} y_{u_k}(t) \\ y^*(t_h) = y(t_h) + e(t_h) \end{cases} \quad G_k(p) = \frac{B_k(p, \theta_k)}{A_k(p, \theta_k)} = \frac{\sum_{j=0}^{M_k} b_{j,k} p^{\beta_{j,k}}}{1 + \sum_{i=1}^{N_k} a_{i,k} p^{\alpha_{i,k}}}$$

Supposing that the fractional commensurate order is known a priori and only the linear coefficients are estimated, the parameter vector takes the following form:

$$\begin{cases} \theta_k = [b_{0,k}, b_{1,k}, \dots, b_{M_k,k}, a_{1,k}, \dots, a_{N_k,k}]^T, & k = 1, \dots, n_u \\ \theta = [\theta_1; \dots; \theta_{n_u}] \end{cases}$$

The main idea is to decompose the MISO model into n_u SISO models and to estimate, using the least-squares and optimal instrumental variables, the parameters θ_k of each SISO model ($k = 1, \dots, n_u$), by minimizing the L2-norm of the cost function:

$$\varepsilon_k(t, \theta) = x_k(t, \theta) - y_{u_k}(t, \theta_k), \quad k = 1, \dots, n_u$$

With

$$x_k(t, \theta) = y^*(t) - \sum_{\substack{n=1 \\ n \neq k}}^{n_u} y_{u_n}(t, \theta_n)$$

A case study is carried out in an academic example and the influence of the commensurate differentiation order is studied. As expected the minimum is located at the true differentiation order.

Prospects:

Gradient-based algorithms can be implemented for order estimation.

Differentiation orders can further be adjusted for each SISO model.

The developed algorithms are intended to be used in climate modeling.

References:

- S. Victor, R. Malti, H. Garnier, and A. Oustaloup. Parameter and differentiation order estimation in fractional models. *Automatica*, 49(4):926–935, 2013.
- H. Garnier, M. Gilson, P.C. Young, and E. Huselstein. An optimal iv technique for identifying continuous-time transfer function model of multiple input systems. *Control Engineering Practice*, 15(4):471–486, 2007

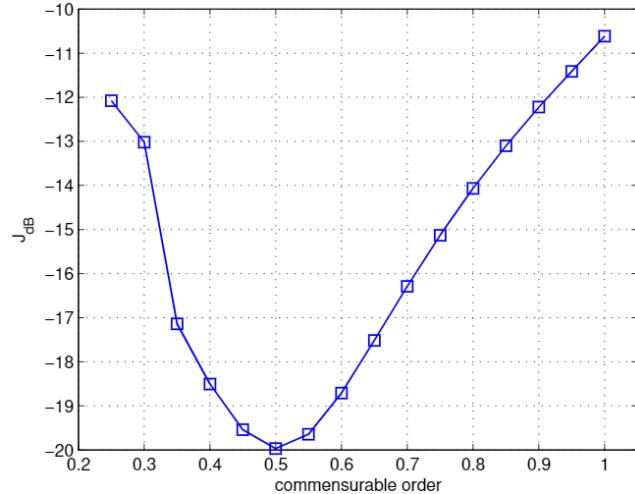


Figure 1 Cost function versus the commensurate order