



Research Grants for PhD students from the China Scholarship Council

First supervisor:	Second supervisor:
Name: Driss BOUTAT Status: Professor E-mail : driss.boutat@insa-cvl.fr	Name: Dayan LIU Status: Associate Professor E-mail: dayan.liu@insa-cvl.fr
Description of the research work proposed for a PhD:	
<p>Title: Non-asymptotic distribution approach for fractional order systems</p> <p>Keywords: Fractional calculus, Non-asymptotic algebraic approach, Distribution theory, Parameter identification, Fault diagnosis, Time-delay.</p> <p>Subject:</p> <p>I. Context</p> <p>I-1. Fractional order systems</p> <p>Fractional calculus was introduced in many fields of science and engineering long time ago. It was first developed by mathematicians in the middle of the ninetieth century. During the past decades, fractional calculus has gained great interest in several applications [1]. For instance, fractional order systems and controllers have been applied to improve performance and robustness properties in control design.</p> <p>Modelling of real physical systems having long memory transients and infinite dimensional structures using fractional order dynamic models has significantly attracted interest over the last few years. For this reason, many identification techniques both in the frequency domain and time domain have been developed to model these fractional order systems. While the most popular technique of Pade approximation is limited by the range of validity of the approximation, most of the other approaches generally suffer from poor speed performance. Moreover, there often exist faults in actuator and sensor of a system. Hence, many different fault diagnosis approaches have been proposed for integer order systems. However, less attention has been paid for fractional order systems.</p> <p>I-2. Algebraic distribution approach</p> <p>Recently, a fast parameters identification method has been proposed for continuous dynamical systems. This method is algebraic, thus non-asymptotic, and robust against corrupting noises. It has been applied in many fields, such as signal processing, control, robotic, etc. Very recently, this method has been extended to state estimation for fractional order systems [2,3,4]. Using the distribution theory, the algebraic method has been extended to time-delay estimation and fault diagnosis for integer order systems [5,6].</p>	

Bearing the previous ideas in mind, the objective of this thesis is to extend the distribution based approach to parameter identification such as time delay, fault diagnosis, and state estimation for fractional order systems.

II. Work plan

- Study existing references on the algebraic distribution approach;
- Study the simulations for fractional order systems with time delay or not;
- Extend the algebraic approach for fractional order systems.

References :

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[5] L. Belkoura, Identifiability and algebraic identification of time delay systems, Time Delay Systems: Methods, Applications and New Trends, Lecture Notes in Control and Information Sciences, 423, 103-117, 2012.

[6] A. Moussa Ali, C. Join and F. Hamelin, Fault diagnosis without a priori model, Systems Control Lett., 61, 316–321.

Professor Driss Boutat

