

# Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website [www-csc.utt.fr](http://www-csc.utt.fr))

Supervisor's name : BOUTAT Given names : Driss

Status (prof., assistant prof., ...) : Professor

Laboratory : PRISME Website address : <http://www.univ-orleans.fr/en/prisme>

Institution : INSA Centre Val de Loire Website address : <http://www.insa-centrevalde Loire.fr/>

Scientific competence of the supervisor:

Prof. Boutat is an international expert on control and observation for non-linear dynamic systems. Until now, he has published more than 100 journal and conference articles. He is supervisor of 9 PhD students (5 have defended). From 2011 to 2017, he was leader of the control team in PRISME. Moreover, he is associate editor of Journal of Nonlinear Dynamics, member of Editorial Board of Discrete Dynamics in Nature and Society and of Mediterranean Journal of Measurement and Control. He earned the Order of Academic Palms Chevalier (Knight) since January 2010. From 2017, he is appointed as a foreign expert of high level by the Chinese government.

Two major publications in the field proposed for the PhD :

1. D. Boutat, and D.Y. Liu, Observer design for a class of non-linear systems with linearisable error dynamics, IET Control Theory & Applications, Vol. 9, pp. 2298 – 2304, 2015.
2. D. Boutat, Extended nonlinear observer normal forms for a class of nonlinear dynamical systems, International Journal of Robust and Nonlinear Control, Vol. 25, pp. 461 – 474, 2015.

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Description of the research work proposed for a PhD Topic # (see list) : I-17

Title : Observer Design for Nonlinear Systems with Multiple Outputs using Nonlinear Observer Normal Forms

Subject :

For engineers, there is always a need of knowing the states of a system in order to make important decisions, to control the system, or to predict reliably its future states. However, in general, it is not feasible or even impossible to directly measure all of the states of a system. In order to solve these problems, the concept of observers has been introduced to efficiently estimate the states of a system. However, it is usually difficult to design an observer for a nonlinear system. In order to solve this problem, the so-called Nonlinear Observer Normal Forms (NONFs) have been introduced for nonlinear systems during the 1980s. The idea is to apply geometrical method to transform a nonlinear system into a NONF on which existing observer methods can be applied. Recently, the theory on the NONFs has been widely developed and promising results have been obtained in several areas, such as automotive, robotics, electronics, electrical engineering, and bio-medical. The main objective of this thesis is to extend the existing results on the NONFs, which can be started by the following steps: characterize multi-outputs nonlinear dynamical systems that can be brought into an extended normal form, generalize the obtained results to the multi-inputs case, and highlight a class of nonlinear dynamical systems that can be transformed into an extended nonlinear observer form without any geometrical computation.

Keywords :

Nonlinear Systems with Multiple Outputs; Observer Design; Nonlinear Observer Normal Forms.

Expected collaborations :

The second supervisor of this thesis is Dr. D.Y. Liu. Dr. Liu's main research interests concern with estimation and identification for integer order systems and fractional order systems, such as state estimation and parameter identification. Until now, he has published more than 50 journal and conference papers. Thanks to his PhD work, he earned the Chinese Government award for outstanding self-financed students abroad. Moreover, his student Xing Wei also earned this award in 2017. In 2018, his student Ang Li earned the Excellent Eiffel award.

Background required from the applicant :

Strong background in mathematics and control; Very good knowledge in mathematical methods applied to control theory, such as differential equations and differential geometry.

Existence of a PDF file detailing the proposal ("yes" or "no") : Yes

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