Postdoctoral Position
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Decentralized adaptive control for parametric switching systems with input/output constraints

Supervisors: Laurent Fribourg (Fribourg@lsv.fr) and Antoine Girard (Antoine.Girard@l2s.centralesupelec.fr)
Location: LSV – ENS Cachan
CNRS –Univ. Paris-Saclay
Cachan, France
Duration: One year, starting early 2018

Context and Objectives

Cyberphysical systems (CPS) are becoming large-scale pervasive systems, which combine various data sources to control real-world ecosystems (e.g., intelligent traffic control, smart manufacturing). Modern CPS have to deal effectively with environment dynamicity. The model of the CPS is not always fully known due to incomplete test data or high sensitivity to versatile environment, and the precise value of some parameters has then to be set on-line [5]. *Adaptive control* is a solution for combining on-line estimation and control. We will focus in the project on *supervisory adaptive control* (or *switching adaptive control*) where a suitable controller is selected on the basis of the current estimate for uncertain process [1].

The first major problem that we will consider in the project is to integrate in the adaptive control a set of given *constraints* (bounds on the parameter domain) on the model or inputs/outputs, without modifying the control objectives (stability, offset-free tracking, target values,…) [6].

The second problem will be to fulfill the control objectives in a *decentralized/distributed* setting, where the system is made of several components, and controllers are designed locally, with only *local information* available from the neighbouring components [3].

This postdoctoral position is proposed within the project CODECSYS (Contract based design of cyber-physical systems) funded by the laboratory of excellence DigiCosme.
The salary is 2250 euros net per month.

Work description

The first part of the work will be devoted to the formalization of parametric models in presence of constraints in the context of switching/supervisory controllers; we will study different parametric models based on *finite impulse response* (FIR) coefficients or *orthonormal basis functions* [6]. The work will be applied to real applications like rolling delta wing [2, 5] or hypersonic flight vehicle [6].

The second part of the work will consist in extensions to the *decentralized/distributed* context: each agent is equipped with a *local supervisor* that switches among the available controllers; the switching decisions made at a certain agent depend only on the information from its *neighboring agents* ; this part of the work will be applied to distributed algorithmic problems like the averaging problem in presence of uncertainty [3].

Background of the candidate

The candidate must hold a PhD in control theory or computer science with a strong mathematical background. Strong programming skills are also needed.

Applications must include a cover letter, a detailed CV, the preprints of the two most significant publications, and two references who may be asked to provide letters of recommendation.

All documents should be sent in a single pdf file to the following email address: mailto:fribourg@lsv.fr

References

[1] J.P. Hespanha, D. Liberzon, A.S. Morse. Overcoming the liitations of adaptive control by means of logic-based switching. Systems & Control Letters 49 (2003) 49—65.

[2] H. Jain, V. Kaul, N. Ananthkrishnan.
Parameter estimation of unstable, limit cycling systems using adaptive feedback linearization: example of delta wing roll dynamics.
Journal of Sound and Vibration 287 (2005) 939–960

[3] A. Khanafer, T. Basar, D. Liberzon. Distributed Linear Supervisory Control. 53rd IEEE Conference on Decision and Control (2014), 1458—1463.

[4] M. Kuipers. Multiple Model Adaptive Control with Mixing. Ph.D. Thesis, University of Southern California (2009).

[5] J. Quian, P. Dufour, M. Nadri. Observer and model predictive control for on-line parameter identification in nonlinear systems. IFAC International Symposium on Dynamics and Control of Process Systems (DYCOPS), 2013, 571—576.

[6] M. Tanaskovic, L. Fagino, R. Smith, M. Morari. Adaptive receding horizon control for constrained MIMO systems. Automatica 50 (2014) 3019—3029.