



### Research Internship:

#### « Anti windup design for nonlinear control »

**To apply :** Submit your CV and a motivation letter to: [vincent.andrieu@univ-lyon1.fr](mailto:vincent.andrieu@univ-lyon1.fr)

**Location:** UCBL1 <http://www.univ-lyon1.fr/>

**Lab:** LAGEPP <http://www.lagep.univ-lyon1.fr>

**Advisors of the stage:** [Vincent Andrieu](#) (CNRS LAGEPP), [Daniele Astolfi](#) (CNRS LAGEPP), [Christophe Prieur](#) (CNRS GIPSA-Lab), [Claire Valentin](#) (Prof. Univ. Lyon1)

**Scientific Domain:** Control theory, mathematics, dynamical system, engineering.

**Objectives, scientific challenges and expected original contributions:** The control devices in engineering consist of microcontrollers which incorporate latent variables which evolve according to the information received by it. However, for the proper functioning of the device, it is important that these variables remain in a certain region where the controller has an optimal behavior. For example, in the case of a dynamic controller, it is usual to use a technique called "anti windup" (see [1] for instance) which modifies the dynamics of latent variables by adding dissipation to them to prevent it deviating too much from their initial values. If the theoretical basis for a finite dimensional linear controller is now well understood, it is however quite different when it comes to non-linear and potentially large-dimension controllers. The objective of the internship is therefore to develop the mathematical theory surrounding these questions (some preliminary results are available in [2]). For instance, a natural question is, given a control law which ensures stabilization of the equilibrium of a dynamical system, what type of dissipation can be added to make sure that the internal variable remains bounded for all exogenous disturbances. An example of a digital application around the temperature regulation of a distributed parameter model which represents the evolution of the temperature of a heated plate will be considered.

**Internship organization:** In the first part of the internship, the student will read and develop new theoretical tools to construct anti-windup control law. The aim is to find some sufficient conditions on the model to allow the design of such an algorithm. In a second step, this theory will be applied in simulation on some particular models.

**Length and remuneration of the stage:** 5 to 6 months with a salary of 550€ net per month, to be effectuated between January 2022 and September 2022.

**Application and expected profile:** We look for a candidate with a strong background in math and or control theory. It can be seen as an initiation towards a research career to be developed in the context of a PhD thesis on related topics. A PhD grant at university Lyon 1 is available.

#### Références :

- [1] Lima, T. A., Tarbouriech, S., Nogueira, F. G., & Torricco, B. C. (2020). Co-design of dynamic allocation functions and anti-windup. *IEEE Control Systems Letters*, 5(6), 2198-2203.
- [2] T. Simon, M. Giaccagli, J.F. Tréguët, D. Astolfi, V. Andrieu, X. Lin-Shi and H. Morel, "Robust Regulation of a Power Flow Controller via Forwarding Design", Submitted to *IEEE Transaction on Control Systems Technology*