LAGEPP – UMR 5007
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Laboratoire
d'automatique,
de génie des procédés
et de génie pharmaceutique

Internship:
« Set-Valued observer via k-contraction theory»

To apply : Submit your CV and a motivation letter to: vincent.andrieu@univ-lyon1.fr

Location: UCBL1 http://www.univ-lyon1.fr/
Lab: LAGEPP https://lagepp.univ-lyon1.fr/

Advisors of the stage: Vincent Andrieu (CNRS LAGEPP), Daniele Astolfi (CNRS LAGEPP), Pauline Bernard (Mînes ParisTech), Claire Valentin (Prof. Univ. Lyon1)

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

Objectives, scientific challenges and expected original contributions: A dynamical system is called k-contractive if the dynamics contracts k-parallelotopes at an exponential rate (see [1]). For instance, for planar systems, 2-contraction implies that areas of a closed shape is a decreasing function of time along the flow. This property may be useful when dealing with estimation algorithms in which the aim is to infer the knowledge of a physical parameter from measurement sensors (see [2]). For instance, in many applications it is of primary importance to show that possible values of the unknown parameter belong to a set whose area is decreasing. The idea of the internship is to develop new theoretical tools and algorithms which exploit k-contractive properties in such a context. A case study on the estimation of population's size in a bioreactor will be used as an academic illustrative example.

Internship organization: In the first part of the internship, the student will read and develop new theoretical tools to construct such estimation algorithms by means of k-contractive theory. The aim is to find some sufficient conditions on the model to allow the design of such an estimation 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. The internship 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.

References :
[1] Chengshuai Wu, Ilya Kanevskiy, Michael Margaliot, k-contraction: Theory and applications, Automatica, Volume 136, 2022
[2] Pauline Bernard, Vincent Andrieu, Daniele Astolfi, Observer Design for Continuous-Time Nonlinear Systems, To appear in Annual review in control.