

# PhD project: reliable AI for cyber-physical systems using realization theory and PAC(-Bayesian) error bounds

We are looking for a PhD student at CRISTAL, University of Lille/CNRS, Lille, France on a topic which is at the intersection of machine learning and control theory.

## Description of the project

In the recent years there has been an increase in application of machine learning algorithms to *cyber-physical systems*. *Cyber-physical systems* (abbreviated as *CPS*) are systems combining computer software with physical hardware and they are an integral part of modern technology (e.g., automotive industry, aerospace, smart buildings, smart grids, manufacturing systems, mechatronics, networked control systems). Cyber-physical systems tend to be safety-critical, and significant research has been done for verification, analysis and control of such systems. When applying machine learning techniques to cyber-physical systems, the situation becomes even more challenging due to the safety critical nature of cyber-physical systems and the presence of physical constraints. The purpose of this project is *to use control theory to provide theoretical guarantees for machine learning algorithms applied to cyber-physical systems*.

More precisely, we plan to provide proofs of statistical consistency and Probably Approximately Correct (PAC) error bounds for learning recurrent neural networks (RNN) from data generated by cyber-physical systems. To achieve this goal we plan to borrow methods from system identification in general, and realization theory in particular. Both fields are subfields of control theory, and they deal with learning dynamical systems from data.

## Prospective candidate

The prospective candidate should have a MSc. degree or equivalent in one of the following disciplines: control engineering/robotics/computer science/machine learning or data science/applied mathematics/statistics/mathematics/physics or a closely related field. The candidate is expected to have some background in one of the following areas: control theory, systems identification, statistics, probability theory, machine learning, or to have solid foundations in either mathematics, or physics or theoretical computer science.

## How to apply

Please send the following documents

- A motivation letter.
- An up-to-date CV.
- Transcripts of the grades related to the highest held degree, if available.
- Copy of your personal works (internship reports, professional experience, employment contracts, etc...) if available.

to the following addresses:

- Prof. Lotfi Belkoura (lotfi.belkoura@univ-lille.fr), CRISTAL lab, University of Lille, France.
- Dr. Mihaly Petreczky (mihaly.petreczky@centraledlille.fr), CRISTAL lab, CNRS, France.