



PhD or Post-Doctoral Position in Deep Learning & Causal Representation Learning for Anomaly Detection– Application to the anomaly detection on light line of the Synchrotron

Research Context

This PhD position is part of the **DALLIAE project** (Anomaly Detection on Synchrotron Beamlines through Explainable Artificial Intelligence), a collaboration between **LIAD (CEA Saclay)**, **NRX Nanostructures and X-Rays Team (CEA Grenoble)**, **the University of Lorraine**, and **the European Synchrotron (ESRF)**. The project focuses on **anomaly detection in Synchrotron beamline experiments using explainable artificial intelligence**.

The objective is to develop **causal Bayesian models** to improve the reliability and interpretability of diagnostics in beamline operations. The research will involve causal representation learning to model and quantify causal links in complex multi-scale systems. Causal graphs will be integrated into a model for anomaly detection as neural network. The developed model will assist in identifying and understanding anomalies in beamline experiments and reducing operational disruptions.

Research Topics

The research will focus on:

- **Developing hierarchical causal graphs** to model multi-scale interactions in beamline instrumentation.
- **Detecting latent variables and quantifying uncertainty** to improve causal inference.
- **Designing a deep learning framework** based on causal representation learning for anomaly characterization.
- **Proposing a surrogate causal model** to support real-time diagnostics and predictive maintenance.

Collaborations and Environment

The position is embedded in an interdisciplinary research environment involving AI, physics, and optics experts. Collaborations with **LIAD, CRAN Lab (Lorraine University), MICS Lab (CentraleSupélec), NRX, and ESRF** will provide access to expertise in machine learning and beamline physics. Publications in peer-reviewed journals and participation in international conferences are expected.

Requirements

- Strong background in **machine learning, deep learning, causal inference, or Bayesian methods**.
- Experience in **anomaly detection, uncertainty quantification, or multi-scale modeling** is an advantage.

Job Details

Duration: 24 months (post doc) or 36 months (PhD)

Project start date: December 2025.

Job location: CEA Saclay.

Candidate Profile

Master or PhD in AI, statistics, machine learning, or applied mathematics.

Skills:

- Proficiency in Python programming for data analysis or machine learning.
- Interest in learning about other disciplines, particularly physics.
- Strong teamwork and communication skills.
- Excellent oral and written English proficiency.

Application Procedure

Applicants are requested to submit the following materials:

- A cover letter applying for the position.
- Curriculum vitae (CV).
- Academic transcripts (unofficial versions are acceptable).

Applications are only accepted through email. All documents must be sent to Aurore Lomet (aurore.lomet@cea.fr), Marianne Clausel (marianne.clausel@univ-lorraine.fr), Myriam Tami (myriam.tami@centralesupelec.fr) and Ricardo Borsoi (ricardo.borsoi@univ-lorraine.fr)