October 2026

Internship offer

Development of Synthetic Data Generation for Rapid Analysis of Synchrotron Data Deep Learning Model

General informations

Workplace: Institut Jean Lamour, IJL (CNRS / UL), Nancy, FRANCE
Duration: 6 months
Start date: Feb/March 2027

Background

X-ray diffraction is an essential technique for material characterization. However, with the rise of high- throughput characterization methods and the advent of fourth-generation synchrotrons, the amount of data generated has increased dramatically, reaching several terabytes within just a few minutes of experimentation. This explosion in data volume requires weeks or even months of analysis using conventional methods, such as the Rietveld method, which struggle to keep up. To address this challenge, automating data analysis has become crucial. Innovative approaches like deep learning could provide an effective solution for processing these massive datasets in real time. Deep learning algorithm could also help to quantify the phase in low amount such as carbides in steels (less than 2 wt% in general).

Objective

The objective of this internship is to develop and test diverse methods to generate synthetic data to train a neural network capable of identifying and quantifying phase fractions in multiphase steels. The generated data will be based on data equivalent to raw experimental data (2D images). McXtrace (https://www.mcxtrace.org/) will be tested as it can simulate all beamline components and simulate X-rays diffraction by Monte Carlo Xray Tracing.

The deep learning model will be used to evaluate the quality of generated data compared to experimental data. After validation, the synthetic data will be generated to broaden the range of studied parameters and be compared to the training on experimental data.

Tasks

- Make a literature review of method for generating data for the particular case of High energy X-ray diffraction and compare to McXtrace.
- Generate synthetic data to complement the experimental data, enriching the variety of studied cases and covering a wide range of experimental conditions.
- Use this data to train the deep learning model, enabling the identification of present phases and their fractions (main phase of steels and carbides).

Profile

- Master's student or engineering school student specializing in materials science, physics, or data science.
- Skills in programming and developing (python) and data management.
- Knowledge of X-ray diffraction and material characterization is a plus.
- Autonomy, initiative, and a passion for applied research projects.

About Institut Jean Lamour

The Institute Jean Lamour (IJL) is a joint research unit of CNRS and Université de Lorraine. Focused on materials and processes science and engineering, it covers: materials, metallurgy, plasmas, surfaces, nanomaterials and electronics.
By 2026, IJL has 243 permanent staff (34 researchers, 131 teacher-researchers, 78 IT-BIATSS) and 389 non-permanent staff (146 doctoral students, 43 post-doctoral students / contractual researchers and more than 200 trainees), from some seventy different nationalities.
Partnerships exist with 150 companies and our research groups collaborate with more than 30 countries throughout the world.
Its exceptional instrumental platforms are spread over 4 sites ; the main one is located on Artem campus in Nancy.

Application

Please send detailed CV and motivation letter to:

- Guillame Geandier : guillaume.geandier@univ-lorraine.fr
- Imed-Eddine Benrabah : imed-eddine.benrabah@univ-lorraine.fr