Scientific Area	Synchrotron Light Applications		
Project Title	Artificial intelligence for operator-intensive coherent X-ray imaging procedures		
Recruiting Institution	European Synchrotron Radiation Facility (ESRF)		
PhD awarding Institution	University Grenoble Alpes (UGA)	**PhD Duration**	36 Months
Supervisor/Institution	Dr Sylvain Bohic / UGA - STROBE		
Co-Supervisor/Institution	Dr Peter Cloetens, Dr Dmitry Karpov / ESRF - ID16A		
Secondment(s)	Visits to the Computational Imaging group of CWI (NL) and PSI – SLS (CH)		

Project Description

This Ph. D. project will explore the potential of artificial intelligence (AI) for the automation of operator-intensive coherent X-ray imaging procedures. It will focus particularly on radiation damage monitoring, automated optimization of reconstruction parameters, and adaptive X-ray fluorescence scanning.
Synchrotron beamlines are scientific instruments that feature advanced metrology, environmental control, and many degrees of positioning freedom for various components. Due to the complex nature of the synchrotron experiments, excessive amount of time at beamlines is spend on such routines as samples screening, data acquisition monitoring, beamline behavior monitoring, and manual optimization of reconstruction parameters. An efficient way to deal with complex systems is by employing AI tools. It allows automating complex repetitive tasks achieving a high degree of optimization without extensive feature engineering. This is achieved through the adaptive nature of AI in contrast to more rigid classical algorithms that require the code developer to account for all possible scenarios. While AI is increasingly used in various fields, synchrotron beamlines are yet to benefit from its potential. This Ph.D. project will be carried out at the ID16A beamline of the European Synchrotron Radiation Facility (Grenoble, France). The beamline combines coherent X-ray imaging techniques and X-ray fluorescence (XRF) microscopy for studies of 3D morphology and composition at nanoscale. Selected Ph. D. candidate will work closely with the beamline staff, exploring AI-based strategies for automation of such crucial tasks as sample and data monitoring, optimization of reconstruction parameters, and adaptive XRF. We expect that the results of this project will help to lay the groundwork for future automated experiments at the ESRF by devising a generic methodology.

Project Objectives

- Develop and explore strategies for automated parameter optimization of the algorithms used at the ID16A beamline for reconstruction of Holographic X-ray tomography data and Near-field Ptychographic X-ray tomography data.
- Develop a monitoring tool for automated evaluation of quality of acquired data and sample's stability under X-rays.
- Develop and explore strategies for advanced X-ray fluorescence imaging, such as adaptive step size for samples with localized features of interest.
- Formulate a generic methodology for the AI based experiment automation.

Required Candidate Qualifications

- M.Sc. in one of the following relevant fields is required: Applied Mathematics, Engineering, Computer Science, Physics.
- Knowledge and experience with Signal Processing and Artificial Intelligence.
- Proficiency in a programming language such as Python, Julia, C, C++, etc.
- Experience with a Machine Learning library such as TensorFlow, PyTorch, Keras etc.
- Good academic records in the relevant fields.
- High-level communication and writing skills.
- Proficiency in oral and written English.
- Good interpersonal skills and ability to work as part of an interdisciplinary team.
- Experience with synchrotron radiation facilities is not required but is beneficial.