Post-doctoral position in synchrotron X-ray computed tomography and materials science

I. Context

Mines Paris PSL and Synchrotron SOLEIL are currently hiring a postdoc in material science. This position can start as early as February 2025 and the funding may extend for up to 4 years. This is a unique opportunity for a to acquire deep knowledge of high performance X-ray tomography at multiple resolutions coupled with advanced data processing using machine learning algorithms.

Mines Paris has an internationally recognized expertise in the field of materials, one of its central research themes, in particular at Centre des Matériaux (CMAT) where, over the past ten years, unique multi-scale 4D characterization of materials using 3D imaging by X-ray tomography has been developed. This enabled significant progress in understanding the plasticity, formability, fatigue and fracture of structural materials, including for recycled light alloys. CMAT also develops AI-based methods for massive data processing as well as original AI assisted mechanics simulations and digital twin approach taking root in 3D imaging of materials (image based simulations, generative approaches).

SOLEIL is the French national synchrotron facility, located on the Saclay Plateau near Paris. It is a multi-disciplinary instrument and research laboratory whose mission is to conduct research using synchrotron radiation, to develop cutting edge instrumentation on the beamlines, and to make these developments available to the scientific community. SOLEIL synchrotron, a unique tool for both academic research and industrial applications across a wide range of disciplines including physics, biology, chemistry etc., opened in 2008. It is used annually by thousands of researchers from France and abroad. SOLEIL is based on a synchrotron source that is state-of-the-art both in terms of brilliance and stability. This large scale facility is a "publically owned" private company, founded by the CNRS and the CEA.

The MATRIX (MAtériaux, Transition écologique, Recyclage et Imagerie X) program aims to develop at PSL cutting-edge research around materials recycling and technologies necessary for the ecological transition. It brings together the knowledge and experience of several PSL members as

well as the Synchrotron SOLEIL. MATRIX will contribute to fostering a virtuous cycle where material waste can be seen as a resource and knowledge-based innovation as a way to reduce our footprint on the environment while helping to strengthen our industry. Within this context, a 4-year postdoctoral position has been funded to target material engineering scientific problems, and in particular those related to recycling, which can be studied thanks to 3D X-ray imaging.

II. Missions

The postdoctoral fellow will be stationed at Soleil and conduct experiments at several beamlines with a primary focus on X-ray tomography experiments at Psiché and Anatomix. He will work under the joint supervision of Henry Proudhon (Directeur de recherche, Mines Paris - PSL) and Andrew King (beamline scientist et Psiché). He will also work in collaboration with other material scientists at PSL University to facilitate beamtime applications for research projects targeting material recycling studies. This includes meetings in Paris and participation in seminars organized within the MATRIX project to disseminate the use of synchrotron radiation for material science studies.

She/He will actively participate to the user-support program (X-ray computed tomography and materials science) and will be involved in the scientific, technical, and methodological activities imaging beamlines. That means preparing the beamline for the experiments, helping the users with the management of experimental setups, data acquisition and data treatment if necessary.

She/He will develop a research program (see next section). She/He will be granted in-house research beam time while also submitting proposals to the peer review committees. She/He will publish her/his results and present them at national and international conferences.

III.   Responsibility and Tasks

The main research topic of the postdoc will be the study of material recycling using 3D imaging. This covers several subtopics under developments at PSL university such as the mechanical properties (mechanical strength, fatigue) of recycled alloys (sometimes called the science of dirty alloys), new material routes to recycle waste from electronic equipment (WEEE), metal recycling through liquid phase

(dissolution of metal scraps in lixiviant foam solutions), enzymatic recycling of plastics, etc. The focus of this research could cover multi-resolution imaging, in situ mechanical testing and innovative 3D imaging experiments of new recycling routes or recycled materials under load. The candidate is expected to be deeply involved in data analysis and in developing automated data processing pipelines.

This is an exciting and rapidly growing field where 3D imaging can really make a difference. Automated imaging processing through AI tools is a key to be able to analyse data from high throughput 4D experiments. To achieve this, supervised semantic segmentation needs to be deployed in production environments (the beamlines). Denoising algorithms and methods to reduce the dose/number of projections will also be tested and implemented. The candidate is expected to play a key role in proposing new data processing routes in close collaboration with the Soleil data analysis group (GRADES). Computing resources at Soleil will be leveraged to train and deploy algorithms in a way that users can utilize them during their beamtime.

IV.   Experience required

The candidate should hold a PhD in mechanics of materials / physics applied to material science or equivalent and have experience in tomography imaging. He/She should have a strong experience in using and developing machine learning algorithms for data processing and be proficient with Python. The candidate must also be able to work in English as the synchrotron is an international environment. The candidate will join an enthusiastic and growing pluri-disciplinary team, benefiting from multiple national and international partnerships. In summary, we're looking for someone curious and talented, dynamic and autonomous, who is not afraid to learn new things and who enjoys working in a team.

To apply for this position, send your resume (which should include 3 references with contact details) and motivation letter to: henry.proudhon@minesparis.psl.eu and andrew.king@synchrotron-soleil.fr