Post-doctoral position on Multimodal Machine Learning for PET/CT and PET/MRI Image Reconstruction

Host institute	Multimodal Biomedical Imaging Laboratory (BioMaps), University of Paris-Saclay / French Atomic Energy Commission (CEA), Orsay, France
Supervisors	Claude Comtat – claude.comtat@universite-paris-saclay.fr Florent Sureau – florent.sureau@universite-paris-saclay.fr
Topics	Image reconstruction; inverse problems; machine- and deep-learning
Duration	2 years, starting in October 2022

A two-year post-doctoral position is opened in the ANR funded MultiRecon project, a collaboration between the LaTIM in Brest, CREATIS lab in Lyon, BioMaps in Orsay, and the Poitiers University Hospital. The recruited person will by employed by CEA and affiliated to BioMaps.

Scientific Context

Positron Emission Tomography (PET) is a medical imaging modality that measures *in vivo* biochemical processes that play a key role in the onset and progression of a disease. Main applications of PET are oncology, neurology and cardiology. PET is a functional modality and is always associated with a complementary anatomical modality such as X-ray Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). PET images are obtained by *tomographic reconstruction*, which is the task of estimating an image from measurement data collected by the acquisition system. PET reconstruction is an ill-posed *inverse problem* and poor Signal-to-Noise Ratio (SNR) in the collected data translates into degraded image quality. While shorter acquisitions and low-dose are preferable due to time constraints and patient exposure to radiations, they result in lower SNR. **The challenge of image reconstruction is therefore to reconstruct an image from a short/low-dose acquisition with acceptable noise**.

Working Hypothesis and Aims

Recent *machine learning* techniques for PET reconstruction have pushed towards less noise [1]. They offer the possibility to reduce the patient dose and the acquisition time without degrading the image quality. These techniques are in their infancy and their utilization mostly limited to single modality images. Multimodal machine learning (MML) aims at buildings models that can process and relate information from multiple modalities.

In the MultiRecon project we will **develop new machine learning reconstruction techniques for PET/CT and PET/MRI multimodal imaging systems**. The hypothesis is that combining the raw data from different modalities with machine learning and *deep learning* based models can further reduce the noise and improve the image quality. More specifically, the candidate will:

- Contribute to the development of new optimization algorithms for multimodal machine learning image reconstruction;
- Integrate these optimization algorithms in the open-source CASToR reconstruction platform [2];
- Apply and evaluate these techniques to PET/CT and PET/MRI data acquired by the project partners.

Profile required

- Education: PhD in Physics, Applied Mathematics or Signal and Image Processing;
- Scientific interest: Computer Sciences, Machine Learning, Medical Applications;
- Programming skills: C/C++, Python;
- Language: English, French optional.

How to apply

For more details on the position, please contact claude.comtat@universite-paris-saclay.fr and florent.sureau@universite-paris-saclay.fr. To apply, send your CV, a cover letter and your PhD grade.