

PhD fellowship: X-ray spectral imaging for phase contrast retrieval

The biomedical imaging labs CREATIS (Lyon) and STROBE (Grenoble) open a PhD fellowship on x-ray spectral imaging for phase contrast retrieval in collaboration with CEA-Leti. The position will be funded by the labex PRIMES. The PhD fellow will be registered at INSA Lyon but he/she will mainly be based in Grenoble.

Medical and scientific context

Medical x-ray imaging will know two major evolutions in the coming years: spectral imaging will be further developed with the advent of photon counting detectors and phase-contrast imaging will be transferred from pre-clinical to clinical applications. The main difficulty with phase-contrast imaging for patients is that it currently requires synchrotron sources or complex optical devices such as grating interferometers, which cannot be easily rotated around the patient. New techniques based on adding a spatially random pattern in front of the x-ray source are promising for clinical use, see e.g. [1].

Objectives

The goal of this PhD fellowship is to investigate phase-contrast retrieval from spectral x-ray images with speckle tracking. Conventional spectral x-ray imaging only considers the attenuation and accounting for the phase requires to model the complex refraction index. Currently, phase contrast images are retrieved by solving a non-linear inverse problem under the assumption that the ratio between the attenuation and the phase is constant or by using several x-ray images acquired at different distances or with different optical configurations. Both the attenuation and the phase depend on the x-ray energy and the assumption of this PhD is that x-ray spectral imaging would provide several measures with a single irradiation to retrieve the phase.

Research program

- Model the inverse problem and identify adequate acquisition parameters (size and voltage of the x-ray source, speckle pattern, spectral and spatial resolution of the detector, etc.).
- Resolution of the non-linear inverse problem, in the projection domain before tomographic reconstruction or directly in the tomography domain.
- Application to Gate simulations and real data acquired at the European Synchrotron Radiation Facility and at CEA-Leti.

Qualifications and position information

- **Education:** Masters degree in computer sciences, physics or mathematics.
- **Scientific interests:** computer sciences (medical image processing), x-ray physics, medical physics, mathematics (inverse problems and tomographic reconstruction).
- **Programming skills:** Python and/or C++.
- **Languages:** Command of English required, French optional.
- **Supervision:** Emmanuel Brun, Simon Rit and Clarisse Fournier.
- **Location:** STROBE, Grenoble, France.
- **Salary (net):** about 1400 euros/month.
- **Period:** 3 years starting after summer 2021.

Contacts

Send CV, master marks and a brief statement of interest by email to **Simon Rit**: simon.rit@creatis.insa-lyon.fr

[1] H. Rougé-Labriet, S. Berujon, H. Mathieu, S. Bohic, B. Fayard, J.-N. Ravey, Y. Robert, P. Gaudin, and E. Brun. "X-ray Phase Contrast osteo-articular imaging: a pilot study on cadaveric human hands". In: *Scientific reports* 10.1 (2020), pp. 1–8. DOI: <https://doi.org/10.1038/s41598-020-58168-3>.