Ultra-fast multimodal X-ray microCT

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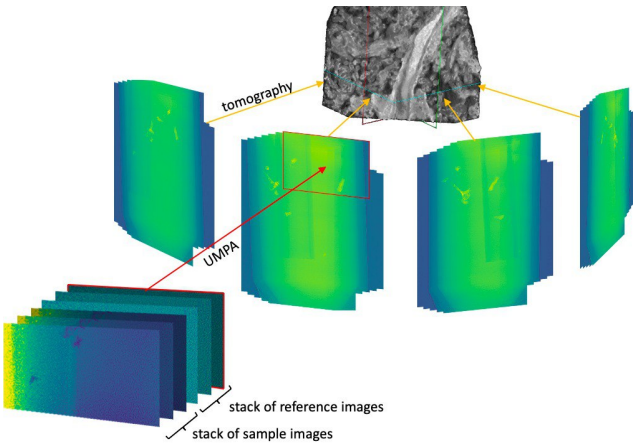
Micro computed tomography (microCT) is a non-destructive imaging technique that uses X-rays to produce detailed 3D images of small objects. In industry, microCT is used for testing and developing new products, while in research it is used for materials science, biology, and engineering applications. Its high-resolution capabilities make it a powerful tool for analyzing the internal structure of small objects with great precision. Image information in normal microCT is generated by the sample's absorption of X-rays. Other interactions, like refraction or scattering, are ignored. Yet, scattering may carry crucial information on the structure of a sample, in particular at scales smaller than the resolving power of the imaging system. The goal of this EU-funded (ERC Consolidator Grant) project "S-BaXIT" (Scattering-Based X-ray Imaging and Tomography, https://s-baxit.optimato.eu) is to develop and apply new scattering-aware X-ray imaging methods, like speckle-based X-ray imaging, and ptychography. Impact of this research ranges from industry (e.g. carbon fiber composites) to biomedical research (e.g. organic fibers and microcalcifications).

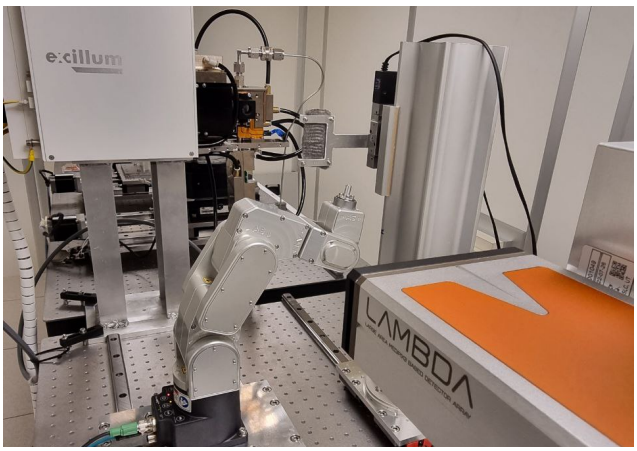
A PhD position funded by this project is now open. In this project, the student will work on new X-ray techniques that exploit information encoding through patterned X-ray beams (e.g., modulation of beam intensity by sandpaper, gratings, or masks). In particular, the successful candidate will (1) develop simulation models for multimodal X-ray imaging of extended three-dimensional samples; (2) plan and participate in benchmarking experiments; and (3) develop next-generation tomographic reconstruction software for fast and accurate processing of patterned-illumination datasets. Data will be acquired with the newly-built X-ray imaging setup in our lab at the Elettra synchrotron. It is equipped with a unique combination of cutting-edge devices, including a high-brilliance liquid-metal-jet X-ray source, a six-axis robot sample manipulator, and a photon-counting pixel array detector.

The candidate should have a good background in optics and imaging. Good programming skills (ideally in Python or C/C++) are essential. Knowledge of X-ray and atomic physics is valuable but not essential.

Interested candidates should directly contact Prof. Pierre Thibault (pthibault@units.it).



The main project idea: combine in a single step the tomographic reconstruction and the signal extraction (done with our own algorithm, the unified modulated pattern algorithm, UMPA).



A photo of the laboratory in its current stage. The sample is manipulated with a robot arm and a photon-counting detector is used to obtain X-ray images of the highest quality.