X-ray scattering in full-field imaging and near-field ptychography

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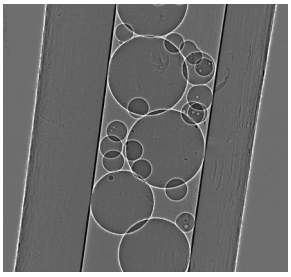
For imaging applications, the scattering of X-rays by different materials is often considered a nuisance that causes deterioration of the images or reconstructed 3D volumes. Yet, coherent and incoherent scattering may carry crucial information on the structure of a sample, in particular at scales smaller than the resolving power of the imaging apparatus. The goal of this project is to develop, validate and apply new scattering-aware X-ray imaging methods. Impact of this research ranges from industry (e.g. carbon fibre composites) to biomedical research (e.g. collagen structure and microcalcifications).

This project is part of the first wave in a series of research projects funded by the recently awarded ERC Consolidator Grant on the theme of “Scattering-Based X-ray Imaging and Tomography (S-BaXIT)”, hosted by the University of Trieste and the Synchrotron Elettra. The focus of the research activities will be on advanced algorithmic methods applied to imaging and tomography.

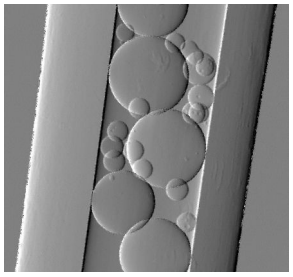
In this project, the student will work on new X-ray techniques that exploit information encoding through patterned X-ray beams. In particular, the successful candidate will (1) develop X-ray scattering simulation models; (2) plan and participate in benchmarking experiments; and (3) manage collaborations with European partners for applications of scattering-aware tomography with relevant biomedical, geological and palaeontological samples. In addition to regular measurement runs done at Elettra and other synchrotron radiation facilities, a high-brilliance liquid-metal-jet source will be used for lab-based experiments.

The candidate should have a good background in optics and atomic physics. Good programming skills (ideally in python or C/C++) are essential. Past experience with X-ray equipment is valuable but not essential.

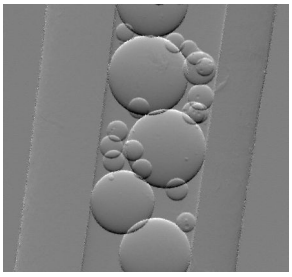
Interested candidates should send a cover letter and their CV directly to Prof. Pierre Thibault (pthibault@units.it).



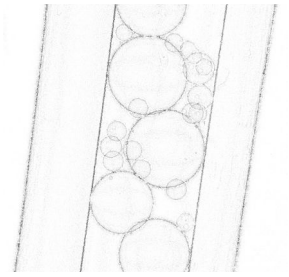
Transmission



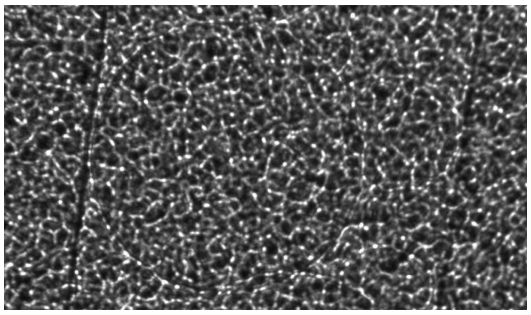
Refraction (x)



Refraction (y)



Dark field



X-ray speckle pattern

Speckle-based X-ray imaging: An X-ray modulator is placed in the X-ray beam to form an intensity pattern at the detector. Depicted here is a random pattern produced by sand paper. This pattern is attenuated and distorted when a sample is introduced in the beam. These small variations are analysed to form images of the sample. Many such images are then combined to form a tomographic volume.