Elettra Sincrotrone Trieste
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Improving nano-positioning for Ptychography through error minimisation and Machine Learning

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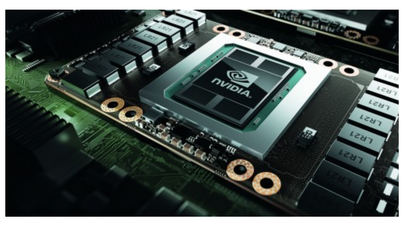
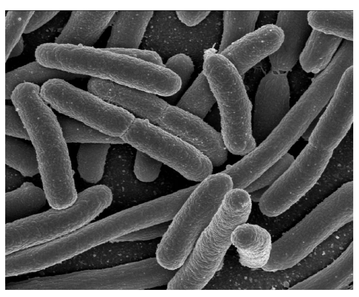
Ptychography is an advanced imaging technique. Its latest developments have allowed for exceptionally high resolution in X-ray microscopy reaching under **5 nm** in synchrotron beamlines. Among its experimental requirements (i.e. coherent beam) there is mechanical precision in moving the sample during scanning. **Special setups** using **precise sample stages** with **nanopositioning** and advanced interferometers **are important**; however, **positioning errors still remain a problem** for many operating laboratories. The knowledge of the precise physical position that the data were acquired **impacts** the resolving power of the **technique**. In this poster presentation we highlight the latest results of a previously published work that developed a computational workflow aiming at refining the individual probe positions of a ptychography scan. We critically assess the **Structural Similarity Index** as a **suitable metric** for **evaluating** the registration in alignment of individually reconstructed probes and suggest the use of a **Machine Learning** strategy for **probe alignment**.

X-Ray Ptychography and mechanical precision problem

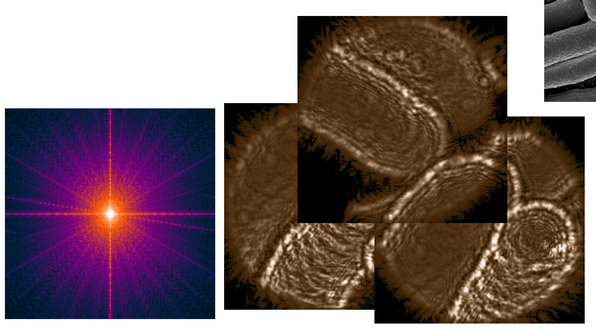
Ptychography is an advanced super-sampling imaging technique that allows for exceptionally **high resolution microscopy** (< 5 nm)



Computationally intensive

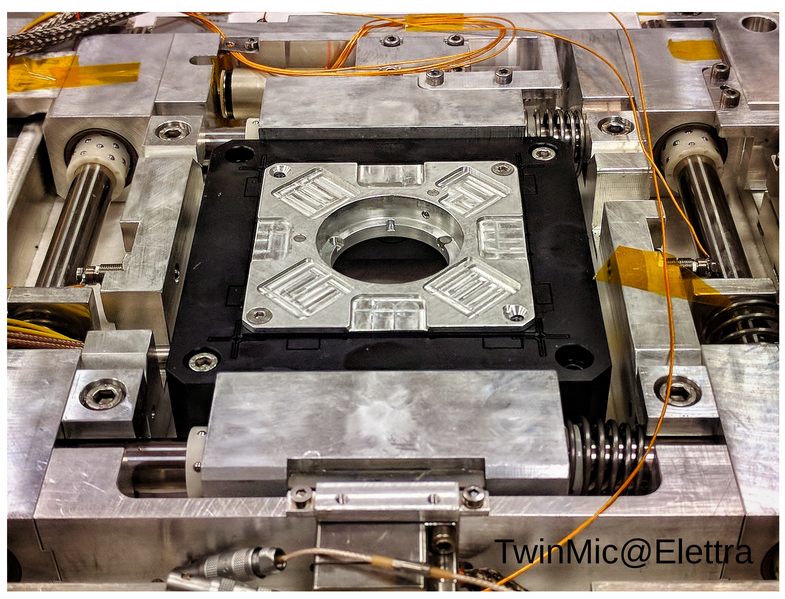


X-Ray Diffraction

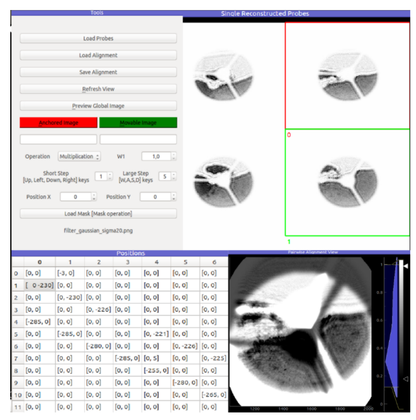


Microscopy

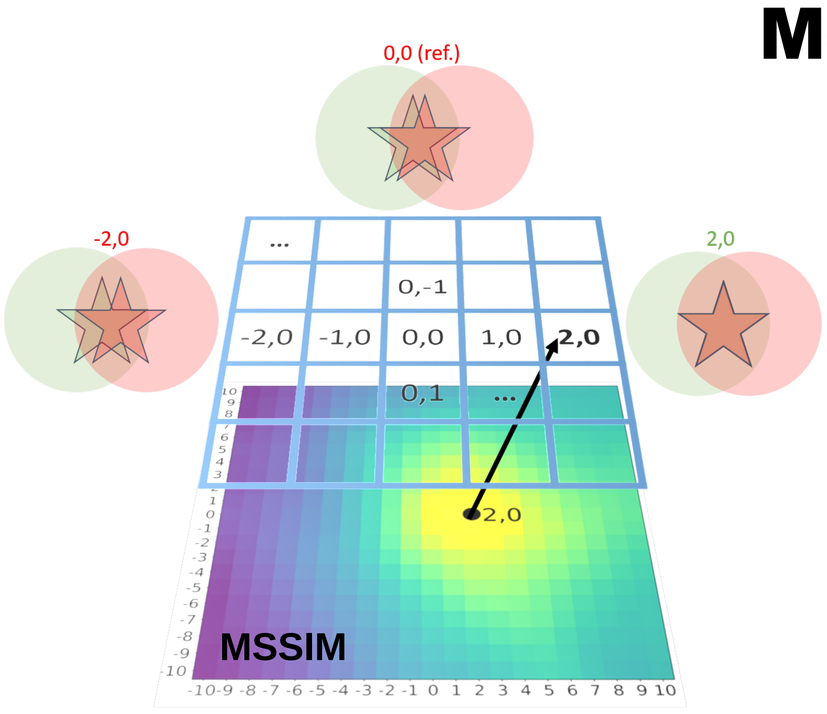
Sample stage **mechanical precision impacts** resolving power of the **technique**.



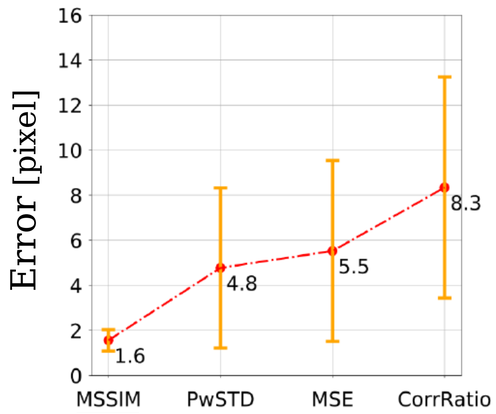
- **Guess** a correct **alignment** that maximises a quality metric.
- Open Source, Python, PyQTGraph

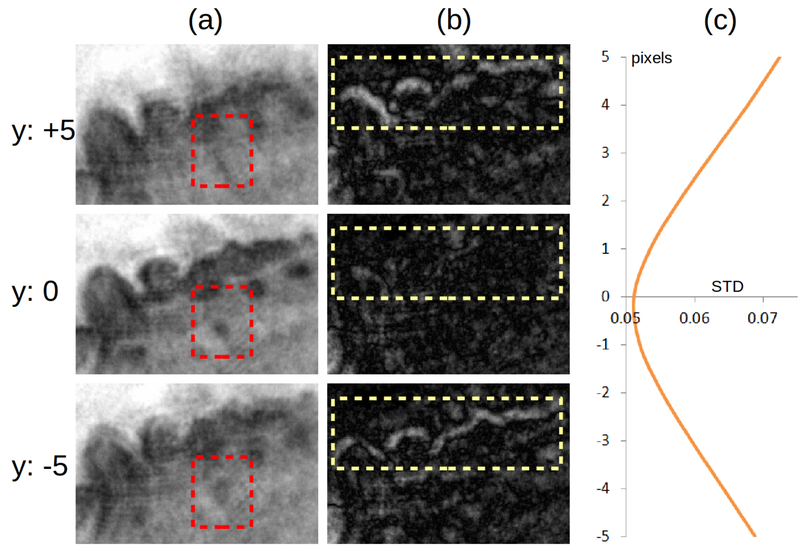


Metric based alignment

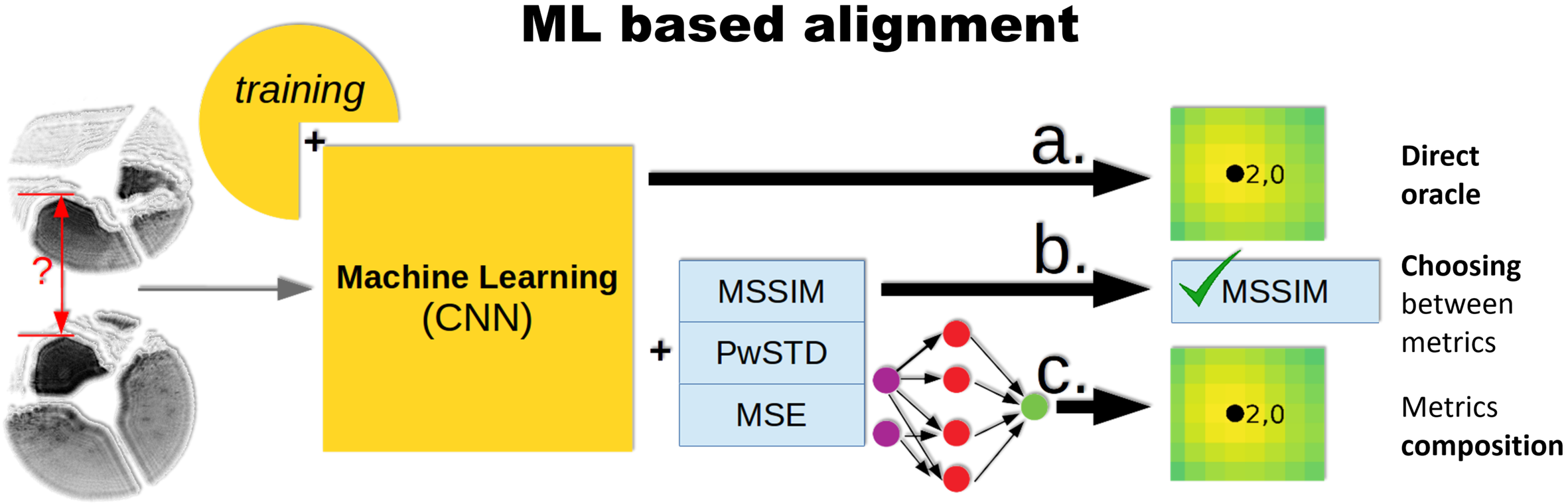


Find **heuristically** an **alignment map** using an **error reduction** strategy on a **quality metric** (Structural Similarity)





ML based alignment



F. Guzzi, G. Kourousias, F. Billè, R. Pugliese, C. Reis, A. Gianoncelli, and S. Carrato,
"*Refining scan positions in Ptychography through error-minimisation and potential application of Machine Learning*", ***JINST,*** *Vol. 13, C06002, (2018)*

Open Source Software in: `https://github.com/ElettraSciComp/PtychoAlignTools`

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