X-ray diffraction imaging with artificial neural networks

Microscopy is the key to studying samples that are too small for the naked eye. Many researchers are interested in matter at the nanoscale, and sophisticated imaging methods are necessary, often making use of x-ray radiation.

High-resolution x-ray imaging may come at the cost of speed, or damage to the illuminated samples because of an excessive x-ray dose. It is therefore interesting to investigate means by which we can boost imaging, retain quality, and sample integrity, and at the same time speed up the characterisation process.

In this project, you will make use of a standard iterative algorithm for reconstructing real images from scanning x-ray diffraction data. You will then try substituting the traditional reconstruction approach by mapping diffraction data to amplitude and phase information with an artificial neural network. This should be much faster, considering it will not have to go through iterations to produce images. Also, it is foreseen that a trained network will be capable to produce high-quality images from fewer scan steps than a conventional iterative reconstruction algorithm. This has major implications for sensitive samples that we would like to illuminate as little as possible!

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