Optimization for Multi-Scale 3D Reconstruction of Ptychographic X-Ray Tomography Data

Slyamov, Azat M.; Ramos, Tiago; Andreasen, Jens W.

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Optimization for Multi-Scale 3D Reconstruction of Ptychographic X-Ray Tomography Data

Azat M. Slyamov, Tiago Ramos, Jens W. Andreasen

Technical University of Denmark, Department of Energy Conversion and Storage, 4000 Roskilde, Denmark

Introduction

Ability to image volumetric structure of nano/microscale systems in material science brings a better understanding of the structure-function correlations that can significantly increase their performance in applied fields. Direct 3D reconstruction from coherent diffraction X-ray imaging (CDI) data requires large computational recourses. Therefore, we present here a multi-scale approach for reducing convergence time by fast reconstruction of low-resolution image and its further application as an input guess for high-resolution reconstruction.

Coherent X-ray diffraction imaging

In CDI experiment an incident wave interacts with a sample experiencing refraction and attenuation and propagates into a far-field detector that measures its intensity given by

\[ I \approx |\mathcal{F}(P \ast \exp(ik \cdot n - 1))|^2 \]

where \( P \) is illumination function, \( n \) is complex refractive index of the sample (object function) and \( \mathcal{F} \) is Fourier transformation.

Future work

Here, we present an extension of the direct 3D ptychographic reconstruction using multi-scale approach. The next step towards decreasing computational costs of the algorithm is to solve the problem of scanning path optimization with instrumental constraints. The final goal is to implement developed algorithm to a real data.

References