COMPARISON OF SEVERAL PHASE RETRIEVAL AND PHASE CORRECTION METHODS FOR SINGLE-IMAGE IN-LINE X-RAY PHASE CONTRAST TOMOGRAPHY

Matthieu N. Boone[1], *Erik L. G. Wernersson*[1], *Manuel Dierick*[1], *Loes Brabant*[1], *Elin Pauwels*[1], *Cris L. Luengo Hendriks*[2], *Luc Van Hoorebeke*[1]

[1]UGCT - Department of Physics and Astronomy, Ghent University
[2]Centre for Image Analyis, Uppsala

ABSTRACT

BACKGROUND

In classic X-ray radiography and tomography, the attenuation of X-rays is used to generate image contrast. In recent years, phase contrast has gained importance in X-ray imaging, mainly at high-resolution tomography. Additional hardware such as grating interferometers can be used to retrieve the local refraction index as well as the local attenuation coefficient. Alternatively, phase contrast can under certain circumstances be generated by in-line beam propagation, creating mixed phase-and-amplitude images. Using images at several distances, the contributions can be separated and complementary information is obtained.

METHODS

In single-image in-line phase contrast tomography, only one mixed phase-and-amplitude image is recorded for each rotation angle. This can be beneficial for image contrast given the edge enhancement effect of in-line phase contrast imaging. Nevertheless, phase effects are often an imaging artefact which hinders proper image analysis. Several methods exist to reduce these artefacts and improve image quality. In this presentation, the most common methods are discussed, emphasizing the advantages and disadvantages. Most methods act on the projection images to retrieve or correct for the phase contrast effects, and reconstruct these corrected projections. However, one post-processing method is also presented, which acts directly on the reconstructed slices.

RESULTS

Two so-called phase retrieval methods result in a higher signal-to-noise ratio thanks to the phase-contrast effect, at the cost of slight smoothing of the data. This allows for 3D analysis of very low-attenuating samples The phase-correcting methods succeed very well in removing the artificial phase edges, without compromising the image sharpness. This is mainly useful in samples with higher attenuation and smaller features. The post-processing method yields results similar to the other methods, but does not require projection data, which extends the application range of phase contrast imaging.

CONCLUSION

All four methods have proven to be a useful tool in X-ray microtomography. They particularly enhance the possibilities in 3D analysis.

Index Terms— X-ray computed tomography; Tomographic reconstruction; Inverse problem solving