High-energy synchrotron radiation has proven to be a powerful tool for the characterization of applied materials and engineering components. Particularly promising is the combination of microtomography (SRµCT) with spatially resolved Wide and Small Angle X-ray Scattering (WAXS/SAXS). It is demonstrated that the for SRµCT relevant runout of a diffractometer designed for interface diffraction can be characterized and corrected to sub-micron precision.

The experiments were performed at the in-line branch P21.2 of the Swedish Materials Science Beamline P21 at PETRA III at DESY in Hamburg, Germany [1]. The rotation stage (Huber 430 X3 W1) is placed 800 mm below the beam and heavy load cross-tilt and XYZ-stages are mounted on top of it. A precision steel sphere with a diameter of 1 mm was fixated by glue immersion in a Kapton capillary and was imaged to characterize the runout of the rotation stage. The scanning parameters were the following; energy: 46 keV, sample-to-detector distance: 30 cm, exposure time: 0.4 s, sample rotation: 180 degrees, no. projections in ranges: 450, 900, 1200 and 1800, effective pixel size: 0.65 µm.

Two different approaches for detecting the runout in X, radial, and Z, axial, directions of the rotation stage were compared. In method 1) Rapid alignment [2], [3] offered by the Tomopy framework [4] was applied on the recorded projections. In method 2) fitting of the attenuation profile in the recorded projections. The quantified runout from both methods was used to align the projections. Hereinafter, Tomopy was used to reconstruct the data sets based on the proposed methods.

Repeated scans of the test sample showed that the recorded runout was reproducible to about 200 nm, i.e. one order of magnitude below the absolute runout. Thus, in a final step the recorded runouts in X and Z from both methods were applied to other various more complex samples, e.g. a lamellar cast iron, paper, carton and foams. It was shown that the recorded runout of the steel ball, using the two proposed methods, could be used as input to correct also the runout in the projections of the final samples. Routine application of either of the two implemented methods will thus minimize further post alignment procedures of the projections and thus speed up the reconstruction pipeline at P21.2.

References: