Data diagnostics in SAXS tomography

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New high-resolution imaging methodologies are required to characterize the structural complexity and heterogeneity of materials in three and even four dimensions (including) time. An emerging imaging technique is *Small Angle X-ray Scattering (SAXS) tensor tomography*, which allows us to determine complete 3D SAXS patterns for every voxel of the scanned volume by solving a six-dimensional problem (three dimensions from tomography and three dimensions for the SAXS patterns in each voxel). This approach results in one million SAXS frames and terabytes of data to acquire for one single tomographic reconstruction. The associated challenge is that, on the one hand, collecting such data is very expensive (for example, using precious time on a synchrotron source) and, on the other hand, the size of relevant data sets becomes so huge that their quality cannot be easily assessed during the measurement (online evaluation). Therefore, our focus is to develop a new tomographic approach based on SAXS using synchrotron radiation, leading to a fast characterization (only a few seconds) of the nanoscale of biological materials. In this direction, we aim at developing new reconstruction strategies, which is better suitable to the considered problem. Our approach follows three basic concepts:

1. Reducing the amount of data already during the measurements focusing on specific problems rather than on full 3D reconstructions of SAXS patterns.

2. Shortening the amount of time for 3D reconstructions applying algorithms on scalars resulting from a linear superposition similar to normal tomography, where the logarithm of the transmission follows a linear superposition principle.

3. Accelerating the reconstruction process so that it can be performed in a few seconds using commercial computer processors.

We believe that these three features make this approach suitable for the implementation of tools for on-line diagnostic and immediate qualitative/quantitative evaluation of data.

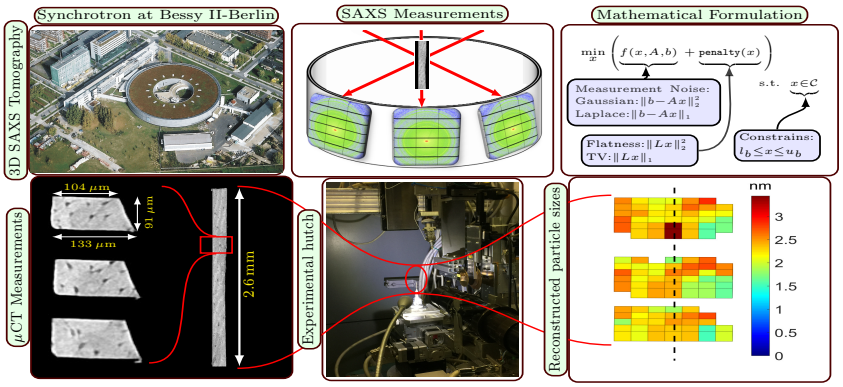

Figure 1: The figure shows the necessary involved steps, resulting in reconstruction of material properties.