BL44B2
RIKEN Materials Science

1. Introduction

BL44B2 is the Materials Science beamline based on total scattering, which includes all coherent scattering such as Bragg and diffuse scattering. Unlike powder diffraction and PDF (pair distribution function) beamlines, total scattering beamlines require a wide dynamic range over 10^5 for the X-ray detector as well as a wide range over 30 $Å^{-1}$ with a step smaller than 10^{-3} $Å^{-1}$ in Q (the magnitude of the scattering vector). The total scattering measurement system OHGI [1] installed at BL44B2 satisfies the required Q range and step.

On the other hand, the dynamic range of an X-ray detector is defined by the difference in X-ray response between detector channels, which is referred to as X-ray response non-uniformity (XRNU). XRNU has been recognized as an issue in all types of X-ray detectors such as imaging-plate detectors, CCD detectors, flat-panel detectors, pixel detectors, and microstrip detectors. To date, the flat-field approach has been adopted to correct scattering data for XRNU. From our experience, coverage of the conventional approach, which may be considered a hypothesis-driven type, was limited to the case where the level of the XRNU noise was higher than several percent.

2. Recent activities

An alternative approach, which is based on the statistical estimation of the reference intensity, has been developed to overcome the limitation [1]. This approach has a problem with the correcting time. Because the acquisition of reference data required at least half a day, it was virtually impossible to correct scattering data for XRNU in accordance with the detector and experimental settings. This greatly impacts the pattern of XRNU. Accordingly, a significant reduction in the correcting time was required.

Recently, the statistical approach has been improved to significantly reduce the correcting time [2]. The improved algorithm increased the utilization rate of data acquired for the reference intensity to 98%. As a result, the correcting time was reduced from half a day to half an hour, which is shorter than the typical measurement time of a sample. Moreover, the present approach yields better correction results than the previous one. The data-driven approach enables an on-demand correction for XRNU in accordance with the detector and experimental settings. The present study should encourage the correction of scattering data for XRNU in area detectors.

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References:

[1] Kato, K. et al. (2019). *J. Synchrotron Rad.,* 26, 762–773.

[2] Kato, K. et al. (2020). J. Synchrotron Rad., 27 1172–1179.