Data Analysis On CHX Beamline

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Coherent Hard X-ray Scattering (CHX) beamline [1] is dedicated to studies of the nano-scale and meso-scale dynamics of materials using x-ray photon correlation spectroscopy (XPCS) with coherent X-ray scattering. To capture rapid material dynamics, the X-ray detection camera (Eiger 1M and Eiger 4M at CHX) must be operated at hundred to thousand Hz, resulting in “Big Data” throughput up to 3 GB/s. Therefore, a powerful tool of data reduction and data analysis is indispensable for successful XPCS experiments.

At CHX, we have developed high-performance XPCS analysis tools based on Python programming language and data analysis can be implemented by different types of Jupyter Notebook pipelines [2,3] according to scattering geometry (transmission or reflection) and sample dynamics properties (e.g., equilibrium or non-equilibrium) . We have applied a fast multi-tau algorithm to the computation of intensity-intensity autocorrelation function ($g^{(2)}(q, t)$) in a near real-time fashion, which is crucial for users to make decisions for subsequent measurements. Beyond the “traditional” $g^{(2)}(q, t)$ analysis method, we have developed other techniques, including X-ray speckle visibility spectroscopy, two/four-time correlation function, spatial correlation function, and two-Q time correlation function, enabling users to extract useful information as much as possible from the “Big Data”.

References

[1] http://www.bnl.gov/ps/nsls2/beamlines/CHX.php
[2] https://github.com/NSLS-II-CHX/chx-pipelines
[3] https://github.com/yugangzhang