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Highly Sensitive Full-Field X-ray Absorption Spectro-Imaging via Physics Informed Machine Learning

Thursday 29 August 2024 12:45 (15 minutes)

Improving the spatial and spectral resolution of 2D/3D imaging of the X-ray near-edge absorption structure (XANES) has been a decade-long pursuit to probe local chemical reactions at the nanoscale. However, the poor signal-to-noise ratio in the measured images poses significant challenges in quantitative analysis, especially when the element of interest is at a low concentration. Recently, we have developed a post-imaging processing method using deep neural network to reliably improve the signal-to-noise ratio in the 2D-XANES images, collected at the FXI beamline at NSLS-II at Brookhaven National Laboratory (see Fig. 1). It is worth noting that the proposed neural network could be trained to adapt to new datasets by incorporating the physical features inherent in the latent space of the XANES images and self-supervised to detect new features in the images and achieve self-consistency. With examples, we will demonstrate the robustness of the model in analyzing the valance states of Ni, Co, Mn in the 2D XANES images with low signals. We will also discuss the generality of the model when applied to different types of elements which have not been seen during the network training. The neural network has been incorporated into the in-house developed PyXAS package and it is freely distributed for general usage.

I plan to submit also conference proceedings

No

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