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Enhancing spatial resolution in MÖNCH detectors for electron microscopy via deep learning

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Hybrid Pixel Detectors (HPDs) have been widely adopted for diffraction-based modalities in electron microscopy thanks to their high frame rates (> 1 kHz) and large dynamic range. However, they are less suitable for imaging applications because of their poor spatial resolution due to relatively large pixels (≥ 25 µm) and to the multiple scattering of high-energy electrons (> 100 keV) in the thick sensor layer. To fully realize the potential benefits of fast, radiation hard HPDs for all modalities of electron microscopy, we are developing deep learning methods to reconstruct the impact points of incident electrons for the 25 µm MÖNCH pixel detector.
We have developed several deep learning models to localize the electron impact point based on both simulations and measured data. Sub-pixel resolution has been achieved for 200 keV electrons. We will show details of the deep learning model training, evaluation results including images of some standard samples, and the data processing pipeline for the MÖNCH detector for its use in electron microscopy.

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