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In-Pixel AI: From Algorithm to Accelerator

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Ptychography is a technique for imaging an object through reconstruction of the diffraction of coherent photons. Through measuring these diffraction patterns across the whole of the object, small scale structures can be reconstructed. In-pixel detectors used for these measurements, the maximum frame rate is often limited by the rate at which data can be transferred off of the device. In this talk, we will present an implementation for lossy data compression through a neural network Autoencoder and Principal Component Analysis integrated into a pixel detector. The 50x compression, together with placing the digital backend in parallel with the pixel array, is used to address major tradeoffs in area, latency, and congestion. The flow from algorithm specification in a high-level language, to High-Level Synthesis into hardware implementation in a 65nm technology, will be detailed. The improvements from these machine learning-based data compression will be analyzed in comparison with full readout and zero-suppression, also implemented in the same technology.

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