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In-Pixel AI: From Algorithm to Accelerator

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Ptychography is a technique for imaging an object by reconstructing the diffraction of coherent photons. By 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 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 - 80x data compression is undertaken by integrating the signal processing and data processing in the pixelated area. We addressed major tradeoffs in area, latency, and congestion typical in such systems. The flow from algorithm specification in a high-level language, to High-Level Synthesis hardware implementation in a 65nm technology, will be detailed. The improvements from these machine learning-based data compression will be compared to prior implementations of full readout and zero-suppressed readout, also implemented in the same technology.

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