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AI-in-Pixel: data compression at source

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The demand for increasingly higher sensitivity and granularity of pixel detectors has resulted in voluminous data generation. A mega pixel readout Integrated circuit with 10b in-pixel ADC operating at 100 kfps generates upto 1Tbps of data. Most of these detectors still rely on full frame readouts creating an IO bottleneck. While zero suppressed and event driven readouts are extremely useful for sparse data environments, often simulated data with 3% occupancy is often closer to 40% occupancy in noisy experimental conditions.

In order to efficiently utilize data bandwidths and create scalable modular structures we need to master the technique of data processing at the source in extremely resource-constrained environments with stringent area, power and latency budgets.

We present the performance and design implementation of two lossy data compression schemes using in-pixel-principal component analysis (PCA) and in-pixel auto-encoder to enable greater than 50x data compression at source. Highly parallel vector matrix multiplications embedded within the pixel with and without preprocessing of in-pixel ADC data is evaluated.

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