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**Introduction (pp. 1-2)**

CNNs are very important, but they require a lot of computation. Optics can offer passive, fast, highly parallel computation. This project explores incorporating optical computing in convolutional neural networks. We present several models and assess their limitations and potential.

**Related work (pp. 2-4)**

CNNs for computer vision

Computational imaging and embedded vision

Optical computing

Optical neural networks

**ONN toolbox (pp. 5-7)**

Convolutional layer

Small kernel, tiled kernels, single large kernel (Fig. 1)

Other layers that we didn’t test – not sure how much to talk much about these

Optical nonlinearities

Max/avg pooling → spectral pooling

Fully connected layers

**Training (p.7)**

We train the ONN offline in Tensorflow

PSF optimization followed by phase mask optimization

end-to-end phase mask optimization

(Appendix)

**Simulations (pp. 8-10)**

Introduce toy classification problem

Understanding constraints (with tf operations)

Learned optical correlator (single optical conv. layer)

End-to-end learning

Hybrid optoelectronic (one optical conv. layer)

Grayscale

With color filters – Vincent?

All-optical convolutional neural network

Doesn’t fully work

**Optical prototype (pp. 10-11)**

Implement the hybrid optoelectronic two-layer neural network

**Discussion (pp. 12-13)**

Not straightforward to generalize first optical conv. layer to multiple optical layers

Discuss importance of negative weights – Vincent?

Exploit other properties of light (polarization, phase)

Coherent light and holography

**Conclusion (p. 14)**

Important step towards optical CNNS