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How to Build and Benchmark an Optical Neural Network Using Multimode Fibres

The utilisation of mode division multiplexing, where multiple spatial modes transmit data simultaneously, holds significant promise for enhancing bandwidth in free space optical communication systems. However, atmospheric turbulence can compromise the reliability of these systems. To address this longstanding problem, traditional neural networks have been employed to classify modes in turbulence. However, these neural networks face challenges relating to energy efficiency, computational speed, and latency. In contrast, optical neural networks offer a potential solution by providing the computational capabilities of traditional networks while mitigating these limitations. In our approach, modal crosstalk within a multimode fibre acts analogously to the weighted sums performed by each layer in a traditional neural network. We demonstrate how to build an all optical neural network using different configurations of multimode fibres, and how to benchmark their classification ability using the MNIST and FMNIST datasets.

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