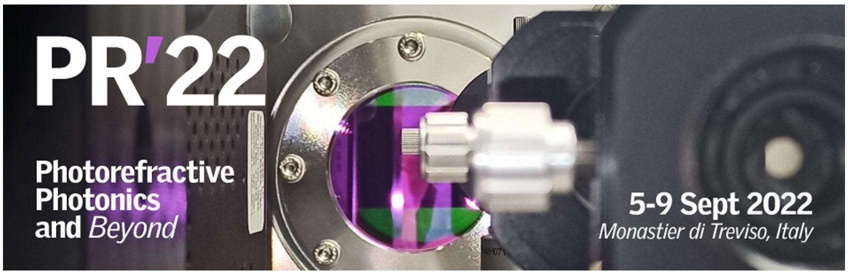

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Programming Nonlinear Optical Propagation as an Optical Computer

Tuesday, 6 September 2022 10:30 (25 minutes)

The ever-increasing need for processing large volumes of data is currently met with electronic processors. However, their limitations such as high power dissipation necessitate new modalities for computing. Optics is a promising contender for lower power operation. However, to achieve computing with the efficiency of light, creating and controlling nonlinearity optically stands as the next milestone. As the medium for this task, multimode fibers are promising candidates, since they can provide useful nonlinear effects while maintaining parallelism and low loss in a small form factor on the order of micrometers. In this presentation we investigate methods for programming these spatiotemporal nonlinearities by wavefront shaping, to control and optimize the performed optical computation. We use a surrogate model which links the various parameters in the system (light intensity, illuminating beam position and wavefront control) to the corresponding performance on a given task. Then, an iterative search algorithm based on a response surface model looks for the optimal set of parameters by creating and refining the surrogate model. This method efficiently programs the optical computer based on light propagation inside multimode fibers with minimal utilization of the digital computer. Inference can be performed even fully optically with accuracies on a similar level to digital neural networks on image classification tasks.

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