Retrieving Optical Information in Nonlinear Chaotic Systems using Neural Networks

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Free-space laser communication through scattering media, where the scattering of light can significantly degrade the quality of communication, has garnered significant attention in recent years. In this work, we unveil a novel application of Neural Networks to recover information from optical holograms subjected to distortion within a highly nonlinear and turbulent liquid medium (Fig.1).

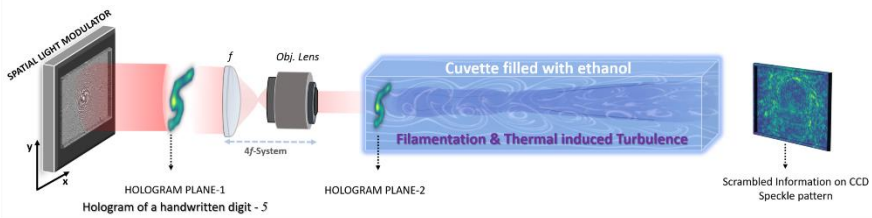

Figure 1: Experimental setup for the generation of handwritten digit holograms and the delivery of this information through a filamentation-induced turbulent liquid medium.

Utilizing three distinct types of neural networks, we effectively reconstructed the original beam profile from intricate speckle patterns, mitigating the adverse impacts of nonlinear propagation and turbulence (Fig.2) [1].

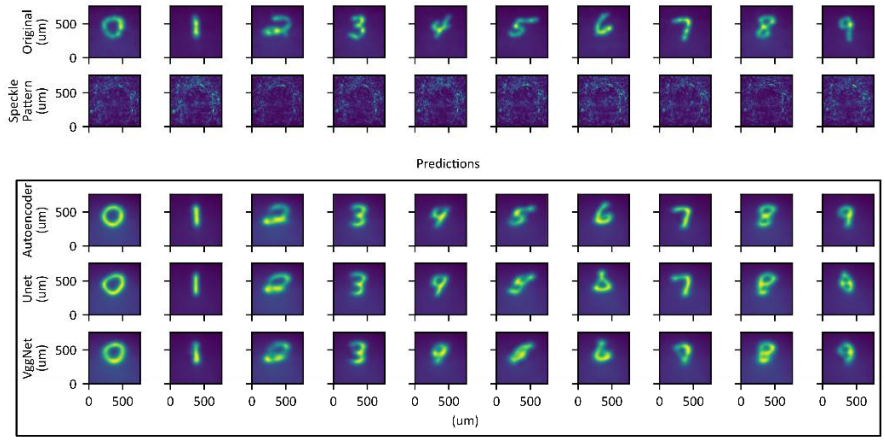

Figure 2: Reconstruction of holograms from the validation dataset for all numbers from 0 to 9 using three different neural network architectures.

Our results showcase the remarkable potential of combining laser filamentation with artificial neural networks to facilitate the transfer and retrieval of information.

References

[1] Panagiotis Konstantakis, et al. Retrieving Optical Information through Propagation in Strongly Nonlinear and Turbulent Systems Using Neural Networks. 26 June 2023, https://doi.org/10.1109/cleo/europe-eqec57999.2023.10231417.