

Visual Data Detection Through Side-Scattering in a Multimode Optical Fiber

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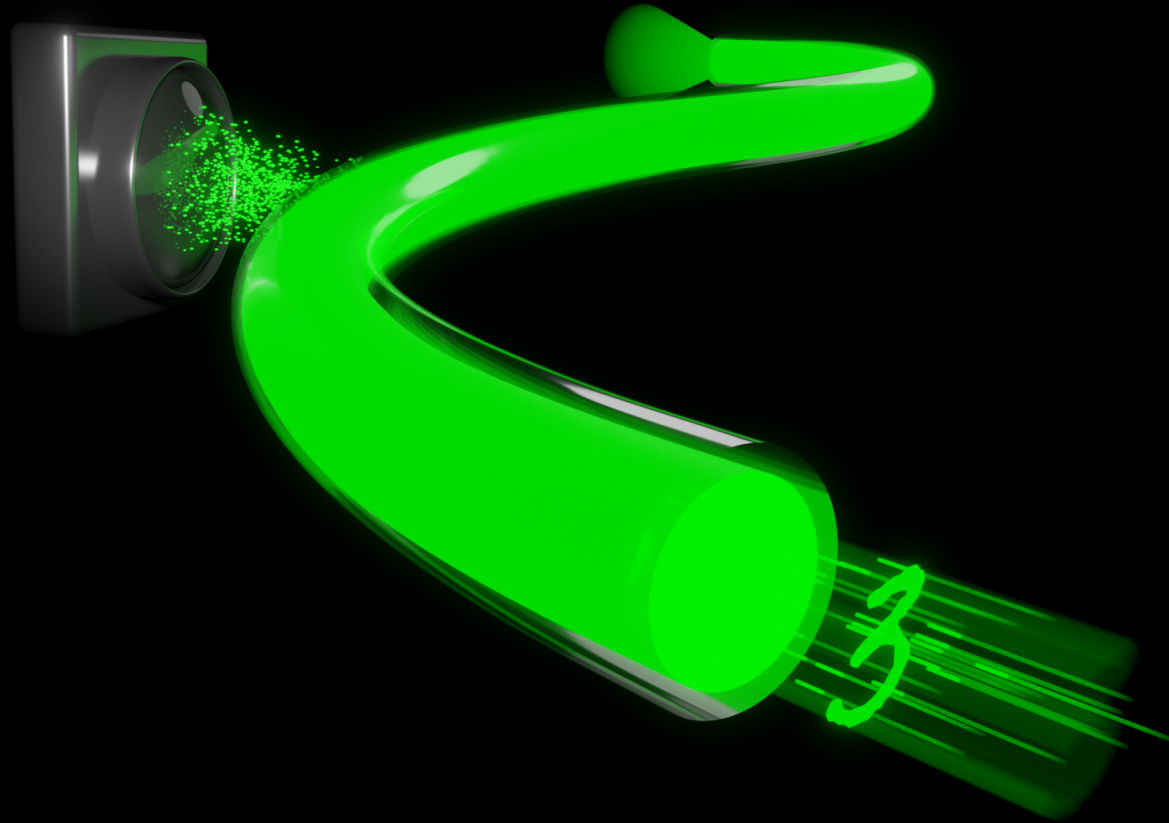
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Abstract

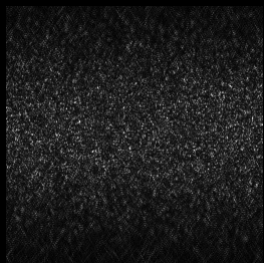
Light propagation in optical fibers is accompanied by random omnidirectional scattering. The small fraction of coherent guided light that escapes outside the cladding of the fiber forms a speckle pattern. Here, visual information imaged into the input facet of a multimode fiber with a transparent buffer is retrieved, using a convolutional neural network, from the side-scattered light at several locations along the fiber. This demonstration can promote the development of distributed optical imaging systems and optical links

The Optical System



Principle of Visual Data Reconstruction

Capture the **side-scattered speckle pattern**



Convolutional neural network



Obtain the **prediction**



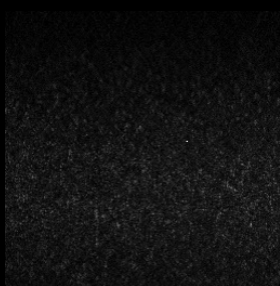
Features

- **Amplitude** modulation
- **Phase** modulation
- Possibility to collect speckles from **multiple points along the fiber**.

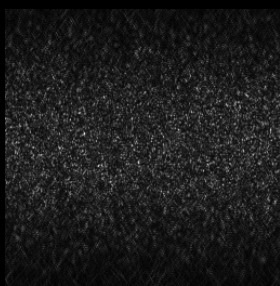
Results

Speckle Pattern Ground-Truth Prediction

Amplitude Modulation
MNIST



Phase Modulation
MNIST



Amplitude Modulation
NotMNIST



Performance

Data-set	SSIM [%]
MNIST, phase modulation	82.65
MNIST, amp. modulation	84.43
NotMNIST, amp. mod.	72.78
Four locations, MNIST, phase modulation	83.11

Future Work

- Generalizing to more complicated patterns, and locations
- Distributed communication network
- Focusing the light at the side of the fiber and using it for distributed imaging.

