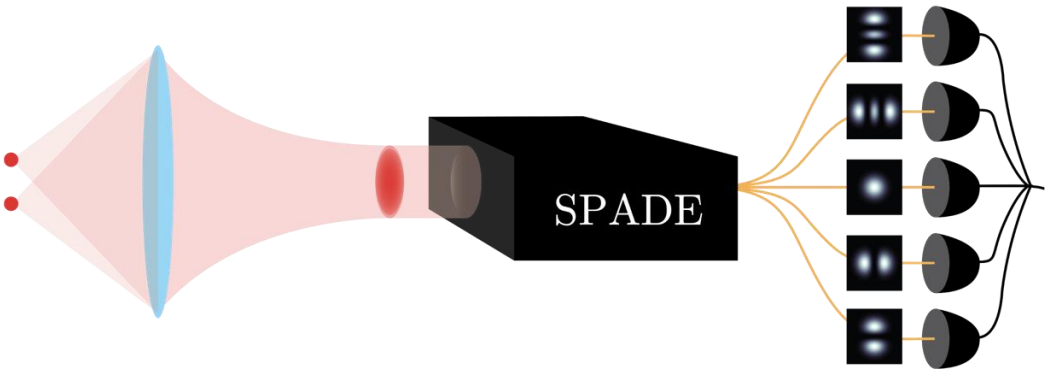
Department Signatorics at the Fraunhofer Institute for Optronics, System Technology and Image Exploitation (IOSB) in Ettlingen is offering an internship about quantum-inspired super-resolution imaging through atmospheric turbulence. Target group are students in the fields of electrical engineering, physics, computer science or similar.

Spatial-mode demultiplexers design for quantum-inspired super-resolution imaging through atmospheric turbulence

The internship would be based in the Adaptive Optics Group where research themes revolve around imaging through turbulence (especially along horizontal paths and strong turbulence) and free-space laser communications. The team develops simulations, theoretical models, image processing software and adaptive optics systems.

More information about the Adaptive Optics Group at Fraunhofer IOSB can be found under www.iosb.fraunhofer.de/adaptive-optics



Motivation

Improving the resolution of imaging systems is of fundamental importance for several fields of science and technology spanning all length-scales ranging from astronomy and remote sensing to microscopy and diagnostic medicine. Traditional imaging approaches rely on spatially resolved intensity measurements, e.g. with a camera, and are limited by diffraction. To go beyond the diffraction limit, one needs to resort to *super-resolution* techniques. Recent works, based on quantum information, revealed that it is possible to achieve super-resolution by means of spatial-mode demultiplexing followed by intensity measurements.

At Fraunhofer IOSB, we study how to adapt these quantum-inspired techniques to the field of imaging through turbulence. A crucial task to reach this goal is the design and construction of the necessary spatial mode demultiplexers. This can be achieved by using multiplane light conversion (MPLC): an established technique that exploits multiple reflections on phase-manipulating optical elements (as those routinely used in adaptive optics setups) to realize arbitrary manipulations of light's spatial profile.

Goals

The student will perform numerical simulations to compare the performances of different available MPLC design algorithms for the realization of a spatial-mode demultiplexer. After identifying the preferred design, it will be tested on an existing experimental setup.

With questions about this project please contact:
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Tasks

- Familiarization with the theory of quantum-inspired super-resolution imaging
- Comparison of known algorithms for MPLC (based on wave-front matching or gradient ascent), and identification of the most suitable method for implementation of a demultiplexer in the existing experimental setup
- Realization and testing of a demultiplexer in an existing experimental setup

What we expect from you

- You are enrolled in a college or university and study physics, engineering, computer science or a similar subject.
- You know the principles of optics and laser physics.
- You are not afraid of delving into quantum information theory and advanced statistics.

What you can expect from us

- You will have access to high-performance computing infrastructure to implement numerical simulations.
- You will have access to exceptionally equipped laboratories, with several unique, not commercially available devices.
- You will be supervised by experts in the fields of quantum optics, optical turbulence, and laser physics.

The position is temporary. The duration of the internship must correspond to the required duration imposed by the sending university.

In case of identical qualifications preference will be given to severely disabled candidates. We would like to point out that the chosen job title also includes the third gender. The Fraunhofer-Gesellschaft emphasizes gender-independent professional equality.

Information about the Institute can be found under http://www.iosb.fraunhofer.de.

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