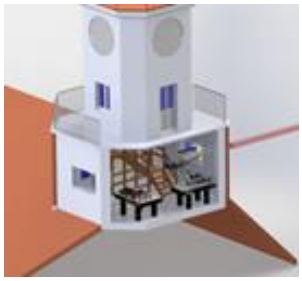
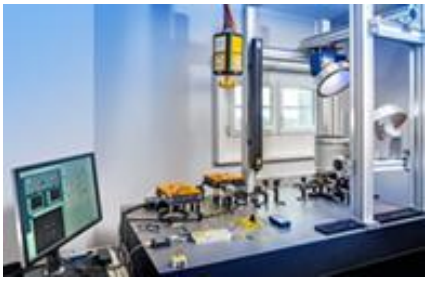
Department Signatorics at the Fraunhofer Institute for Optronics, System Technology and Image Exploitation (IOSB) in Ettlingen is offering a master's thesis on the subject of free-space laser communications. Target group are students in the fields of electrical engineering, physics, computer science or similar.

Master's thesis – Analysis of the effects of atmospheric turbulence on long-range, laser-based, optical communications

The thesis is 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

Free-space (not cable/fiber-dependent) optical communications offers a huge potential for many applications involving the transfer of large amounts of data. Still, the limitations imposed on the deployment of such systems by atmospheric effects are significant. In the department Signatorics we work to counter these effects and enable high-data-rate terrestrial and space-to-ground optical communications.

Putting aside completely disruptive phenomena such as rain or fog, atmospheric turbulence influences the power delivered to the terminal and the number of errors in the transmission. Fraunhofer IOSB addresses the problem with advanced adaptive optics (AO) technology. In the AO laboratory in Ettlingen we develop solutions to the most challenging problem of laser propagation over distances longer than ~1 km through strong turbulence near the ground. The effects encountered over such paths are quite different from those faced by astronomical AO, and therefore unconventional approaches to the problems must be developed.

Goals

Atmospheric effects on data transfer will be studied using the existing 7-km laser path between Fraunhofer IOSB site in Ettlingen and the KIT. The student will use existing, or develop new, theoretical models to predict the effects that turbulence will have on various experimental observables. One of the goals is better understanding of the requirements placed by turbulence on the performance of AO. Nevertheless, real-time AO correction of atmospheric turbulence is not foreseen in this project.

With questions about this thesis please contact:
Dr. Szymon Gladysz
Adaptive Optics Group Leader
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Tasks

- Characterization of the effects of atmospheric turbulence on the already running experiments: prediction and analysis of beam wander, beam profiles in the pupil-, and in the focal plane, temporal power spectral density of scintillation and angle of arrival
- Modelling of the probability density function of the received signal
- Prediction and measurement of the bit-error rate of the data transmission

What we expect from you

- You are enrolled in a college or university and study electrical engineering, physics, computer science or a similar subject
- You know the principles of optics and laser physics
- You are not afraid of delving into higher mathematics

What you can expect from us

- The laser link, the transmitter and the receiver and other equipment are all set up and at your disposal; focus of this master's thesis is theoretical modelling of laser propagation through the atmosphere and analysis of experimental results
- You will have access to exceptionally equipped laboratories, with several unique, not commercially available devices
- To will be supervised by experts in the fields of: turbulence, telecommunications and laser physics

The position is temporary.

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.

Fraunhofer is Europe's largest organization for application-oriented research. Our research efforts focus on people's requirements such as health, security, communication, mobility, energy and environment. We are creative, we shape technology, we design products, we improve processes, we open up new paths.

Employing about 700 men and women at five locations, Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB is one of the largest Fraunhofer Institutes. Our range of competences includes physics and computer science as well as geoscience and engineering. These are the domains where we convert the latest insights into innovations. To this end, our DNA includes both scientific and technological excellence as well as customer-orientation and reliability for clients from industry and the public sector.

Have we attracted your attention?

Then send your application by https://recruiting.fraunhofer.de/Vacancies/52170/Description/2 (short cover letter, CV, certificates or a transcript of grades) until **30.06.2020**.

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

Job Reference: **IOSB-2020-30** Closing Date: **30.06.2020**

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