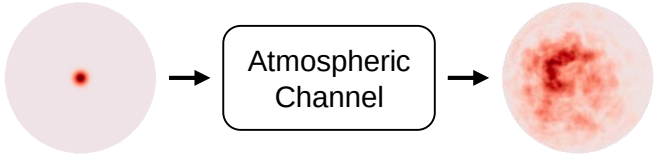
Bachelor / Master Thesis:
Coherent Free-Space Optical Communications

Karlsruhe Institute of Technology

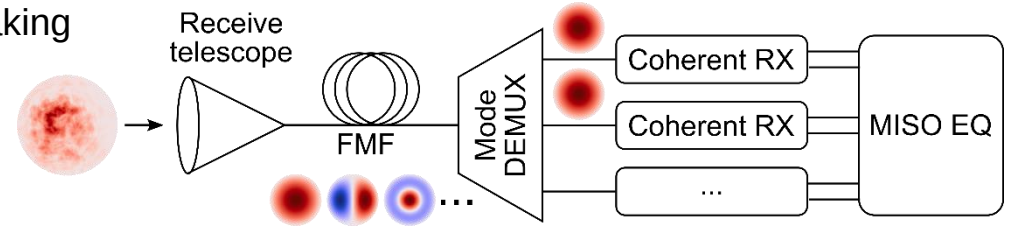
Atmospheric turbulence severely limits the performance of Free-Space Optical Communication (FSO) systems. This behavior is due to the distortion of the propagating light, limiting both the achievable data rates and link lengths. In particular, this phenomenon affects coherent FSO, which typically relies on fiber-coupled receiver components. Coupling a Gaussian beam that traversed the atmospheric channel in the absence of turbulence to a single-mode fiber (SMF) does not imply significant loss. However, distortions of the associated wavefront, such as the ones introduced by turbulence, hinder the free-space-to-fiber coupling notably. Fortunately, replacing the SMF with a few-mode one (FMF) decreases the occurring loss. Transferring the light carried by this fiber to a mode demultiplexer that feeds multiple coherent receivers yields just as many electrical signals. Finally, a digital multiple-input single-output (MISO) equalizer mitigates the effect of turbulence. At IPQ, we are just starting to dive deeper into this topic.

Your tasks could comprise:

- Investigate the turbulent channel analytically and numerically.
- Study the effect of simulated turbulence on coherent FSO experimentally.
- Extend the atmospheric channel model by taking phenomena beyond turbulence into account.



The turbulent atmospheric channel can lead to severe wavefront distortions.



Concept of the turbulence mitigation setup. RX = Receiver, DEMUX = Demultiplexer.

For detailed information contact:

M. Sc. Jonas Krimmer
jonas.krimmer@kit.edu
Tel. 0721-608-42487

Prof. Dr. Sebastian Randel
sebastian.randel@kit.edu
Tel. 0721-608-42490