University of Stuttgart
Institute of Electrical and Optical Communications

BA/FA/MA
Mode Multiplexing using Multi-Plane Light Conversion (MPLC)

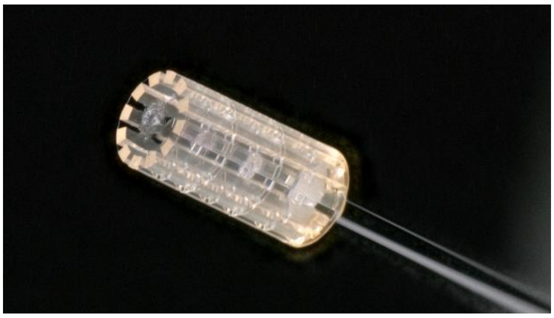
Objective:
Optical systems and simulation development, Spatial mode conversion, Measurement technology (photonic)

Your profile:
- Interest in advanced optical fiber communication and Space-Division Multiplexing (SDM)
- Basic knowledge in Python, MATLAB, and Zemax
- Motivation to work with numerical simulations and phase optimization

We offer:
- Individual supervision and scientific guidance
- Freedom to develop and test your own design and optimization ideas
- The opportunity to work on a cutting-edge research topic in MPLC and SDM
- Access to state-of-the-art simulation tools and photonic lab facilities

Background:
Growing data demands drive the need for scalable and efficient optical communication systems. Space-Division Multiplexing (SDM) enables parallel data channels through distinct spatial modes in few-mode fibers. To realize this, precise mode transformation and coupling are essential. Multi-Plane Light Conversion (MPLC) is a promising approach that uses a sequence of optimized phase masks to transform Gaussian beams into orthogonal spatial modes, such as Hermite–Gaussian and Laguerre–Gaussian. Understanding and simulating this process is key to developing compact, low-loss mode converters for future optical networks.

Your task:



This project focuses on the numerical analysis and practical implementation of spatial mode conversion using MPLC. It includes: 1. Developing a numerical simulation framework to model Gaussian beam propagation through phase masks. 2. Implementing novel phase optimization algorithms to achieve efficient mode transformations. 3. Visualizing and analyzing beam evolution along the propagation path and mode coupling efficiency. 4. Investigating scalability and potential loss mechanisms for multi-mode communication systems. 5. Extending the simulations toward experimental realization, including 3D printing of optimized phase masks, mode-profile measurements, and validation of numerical predictions.

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