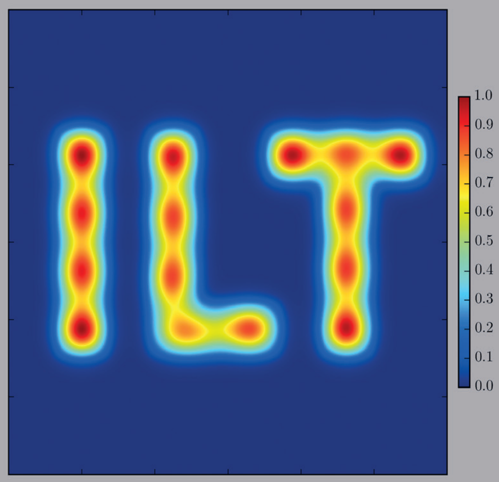

INVESTIGATION OF TRANS-VERSAL MODEM COUPLING IN OPTICAL FIBERS

Task

Non-linear effects largely limit the maximum achievable power density in active and passive optical fibers in the single mode regime. Multimode fibers, however, can be used to overcome these limitations. Since mode coupling effects play a major role in the propagation of radiation, they significantly influence its homogeneity and beam quality. For this purpose, a mode-based simulation was developed, which analyzes how different fiber parameters, such as the core geometry or the numerical aperture, influence the achievable beam densities.

Method

A simulation based on the finite element method (FEM) was developed to calculate the eigenmodes of step index fibers with arbitrary fiber geometries and refractive index profiles. For the modes thus determined, the extent to which intrinsic and extrinsic factors – such as inhomogeneities or bending losses – influences modal propagation and mode locking in dielectric waveguides can be identified.

3 Example of a near field characteristic for fiber with ILT-shaped refractive index profile.

Results

Thanks to the simulation, Fraunhofer ILT is able to examine arbitrary fiber geometries in terms of their mode characteristics and bending sensitivity. Furthermore, it has used the simulation to determine the mode locking of transverse modes due to periodic structures and stochastically distributed perturbations in the fiber. With this understanding, the institute can selectively use the mode coupling, e.g., for the homogenization of the radiation, to influence the properties of the radiation. Current projects are working on implementing and testing the fibers designed in this way.

Applications

The new simulation tool allows users to selectively create new fiber designs optimized, for example, in terms of their achievable performance or beam homogeneity. Fields of application lie in industrial or medical areas where high power or application-specific beam profiles are required. With special fibers, new applications can be made possible and existing ones made more efficient.

The R&D project underlying this report was commissioned by the Federal Ministry for Economic Affairs and Energy (BMWi) under grant number ZF4328102AB6.

Contact

Patrick Baer M.Sc.
Telephone +49 241 8906-8251
patrick.baer@ilt.fraunhofer.de

Dipl.-Phys. Oliver Fitzau
Telephone +49 241 8906-442
oliver.fitzau@ilt.fraunhofer.de