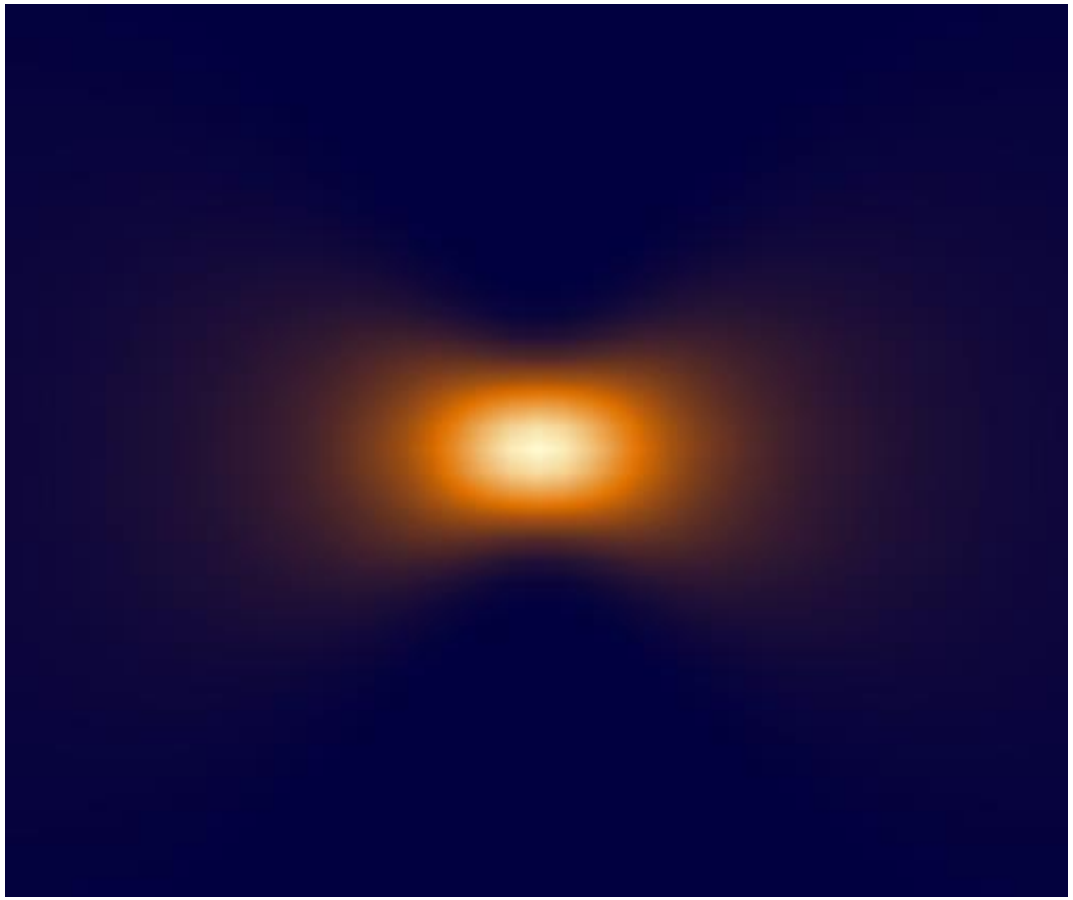
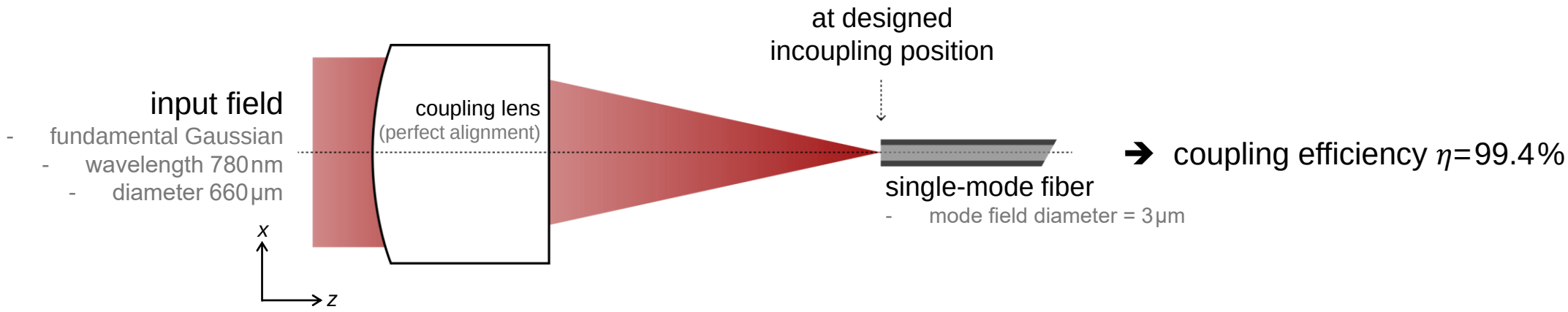
Tolerance Analysis of a Fiber Coupling Setup

Abstract

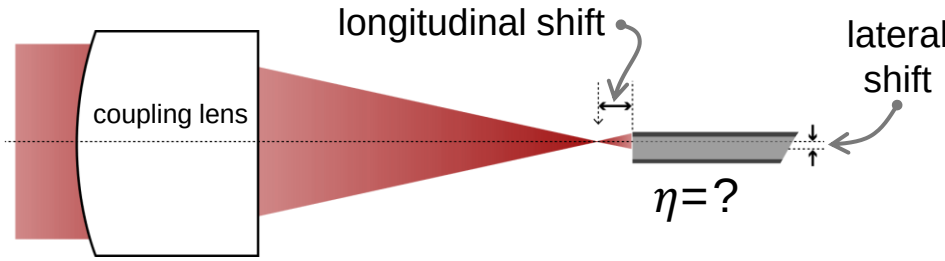


In modern optics, fibers can be found in various optical system, and it is usually of concern how much light can be coupled into fibers. The coupling efficiency can be sensitive to the system alignment, especially for single-mode fibers with relatively small core diameters. In this example, a well-designed fiber coupling lens is selected and the coupling efficiency is evaluated with respect to different tolerance factors, such as the shift of fiber end position and the tilt of coupling lens.

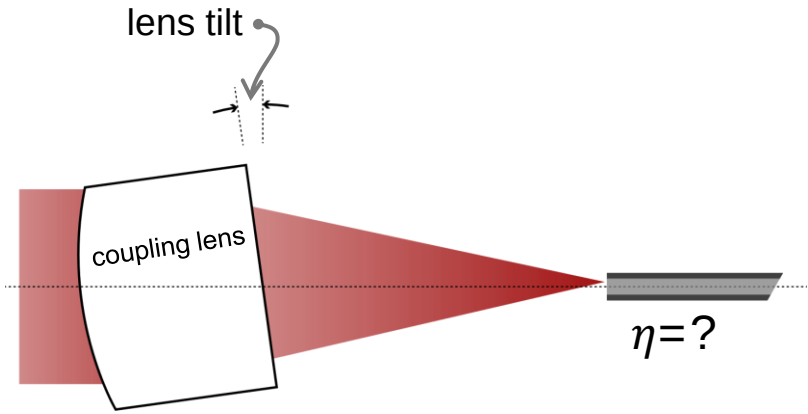
Modeling Task



How does the coupling efficiency change with respect to alignment tolerance factors?

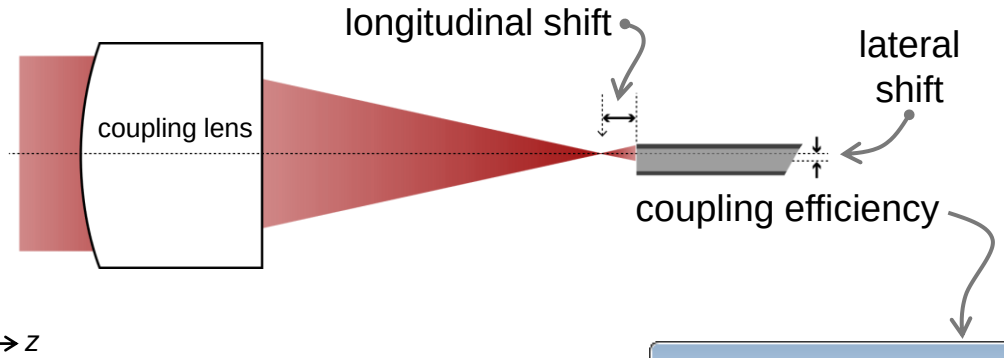


(a) shift of fiber end position



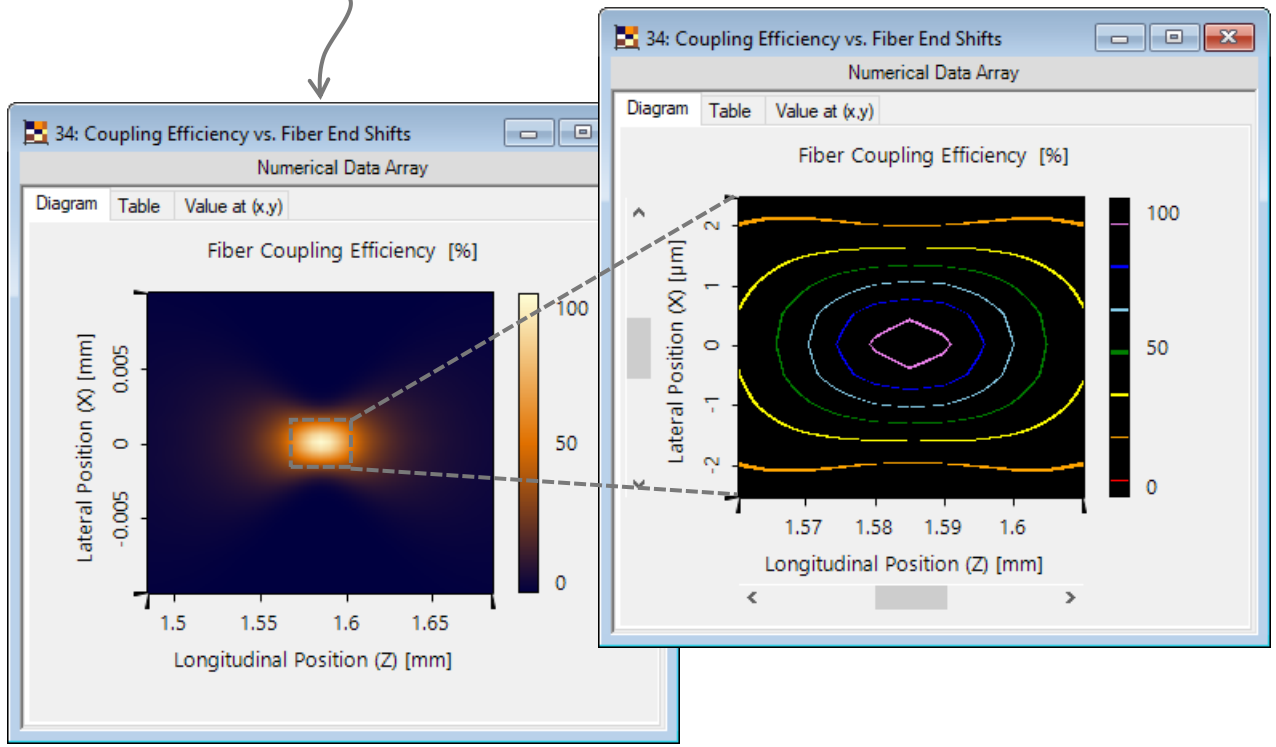
(b) tilt of coupling lens

Coupling Efficiency vs. Fiber End Position Shift

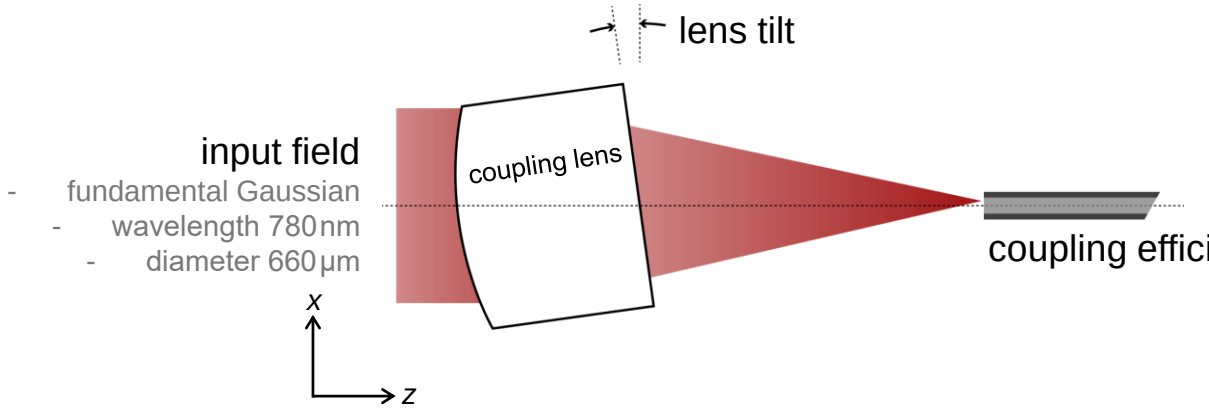


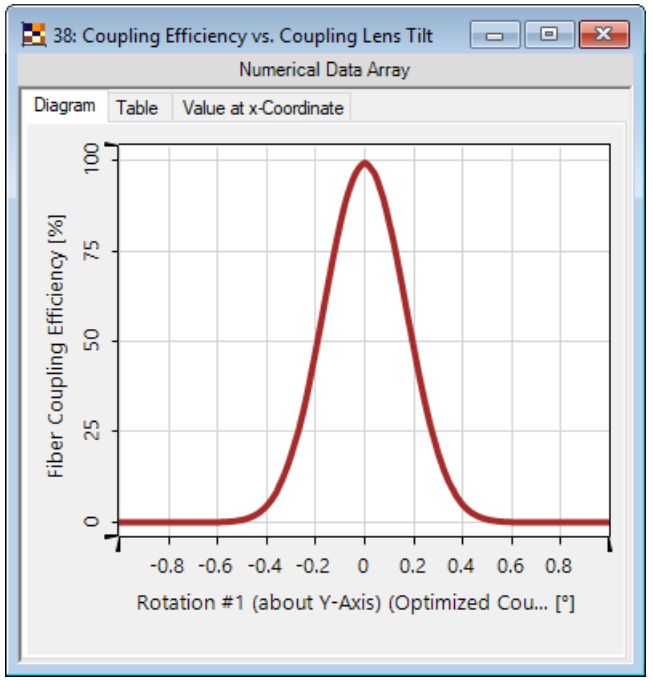
Contour plot helps with the identification of the parameter range for desired coupling efficiency threshold.

The coupling efficiency is scanned with respect to the fiber position shifts along both axial and lateral directions.



Coupling Efficiency vs. Coupling Lens Tilt

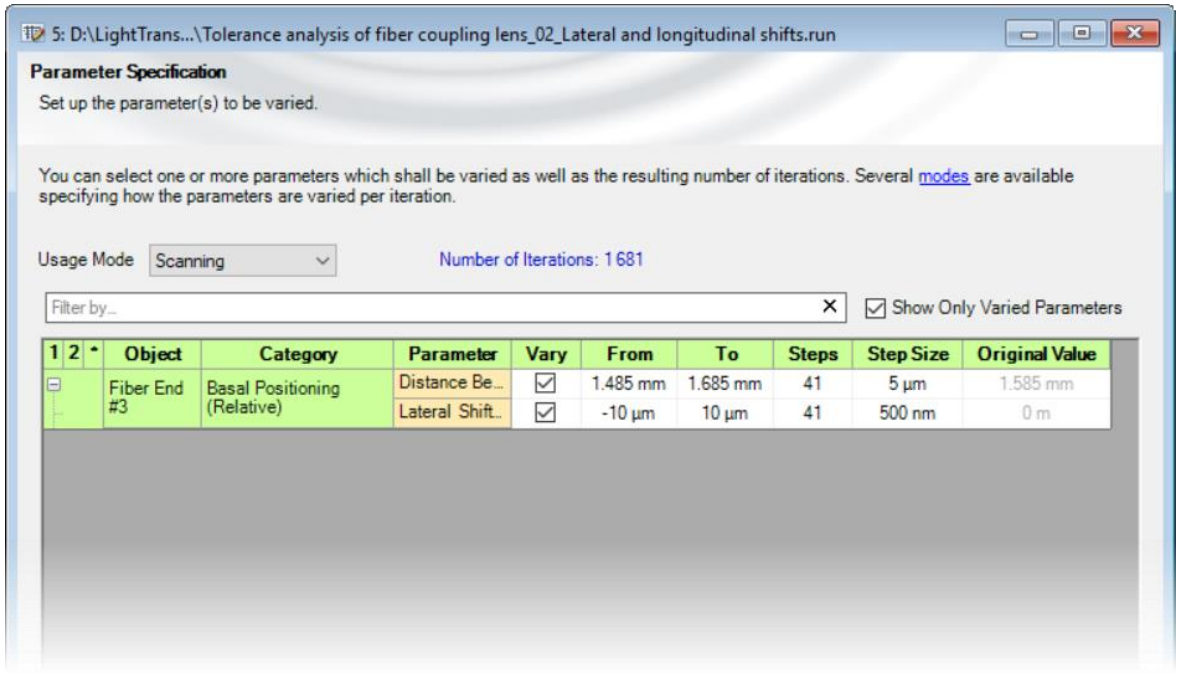


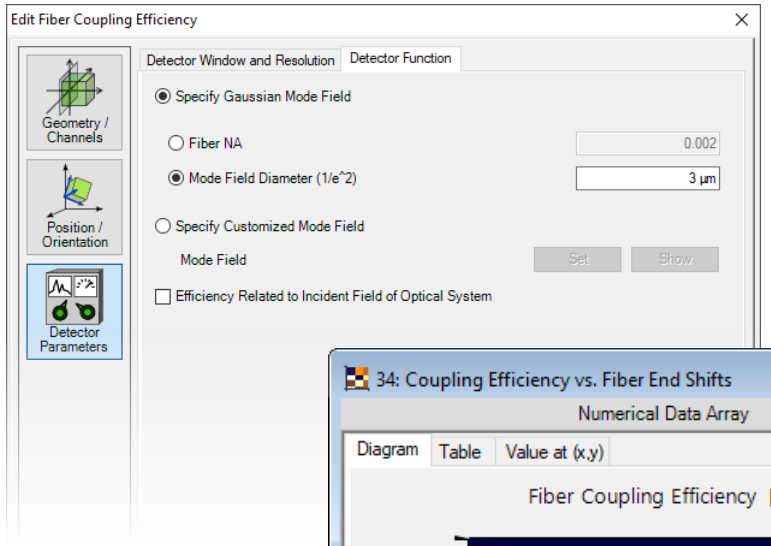


Physical-optics analysis of the coupling efficiency with respect to lens tilt, over 200 angles, takes only 50 seconds.

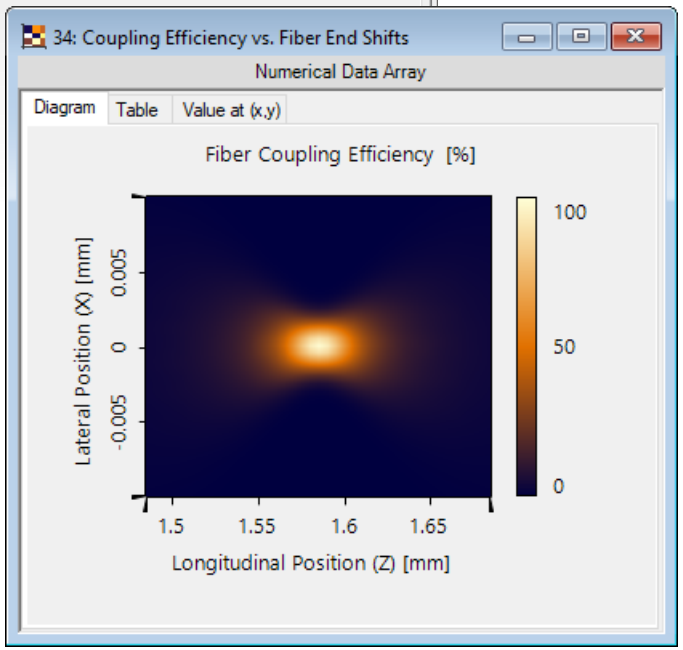
Peek into VirtualLab

multi-dimensional scanning of system parameters





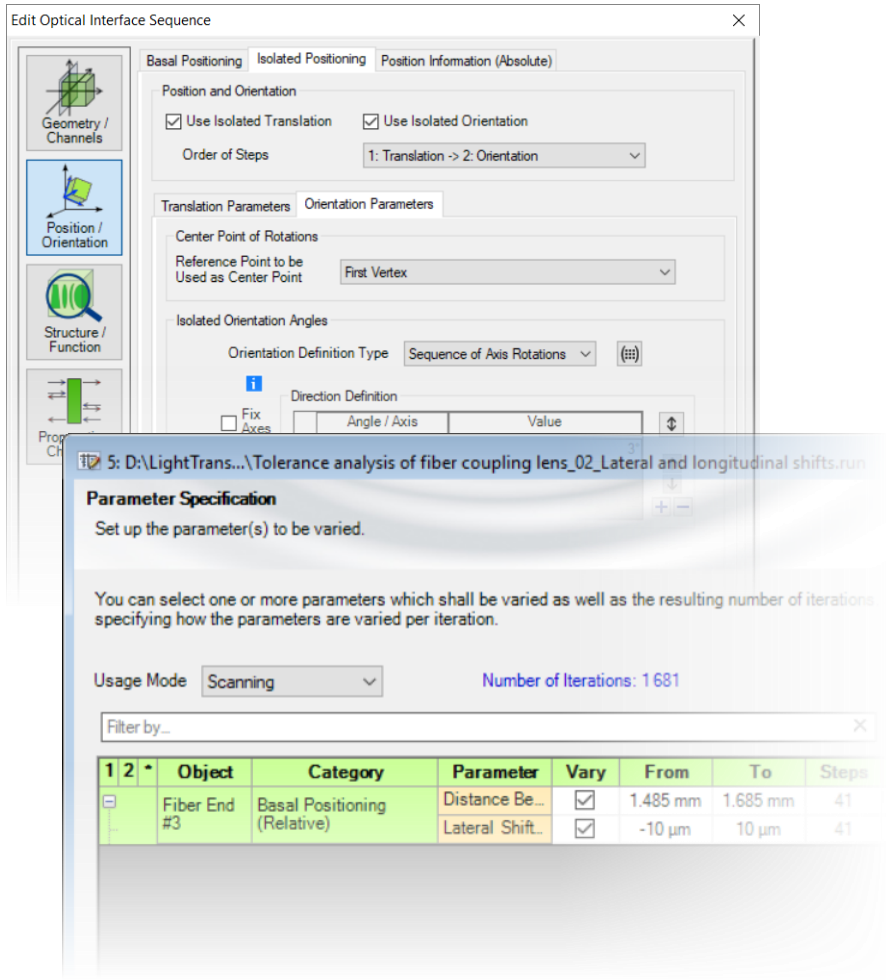
visualization of coupling efficiency vs. tolerance factors



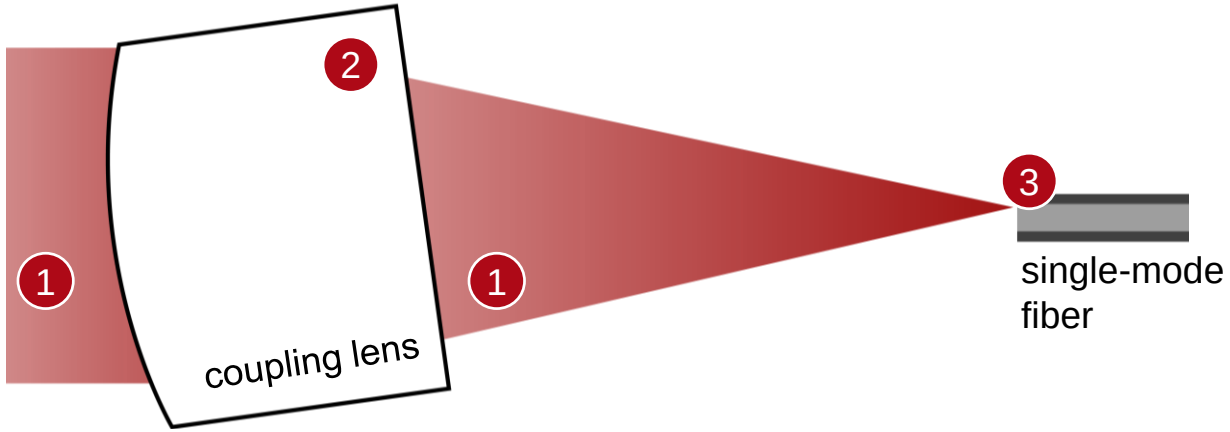
Workflow in VirtualLab

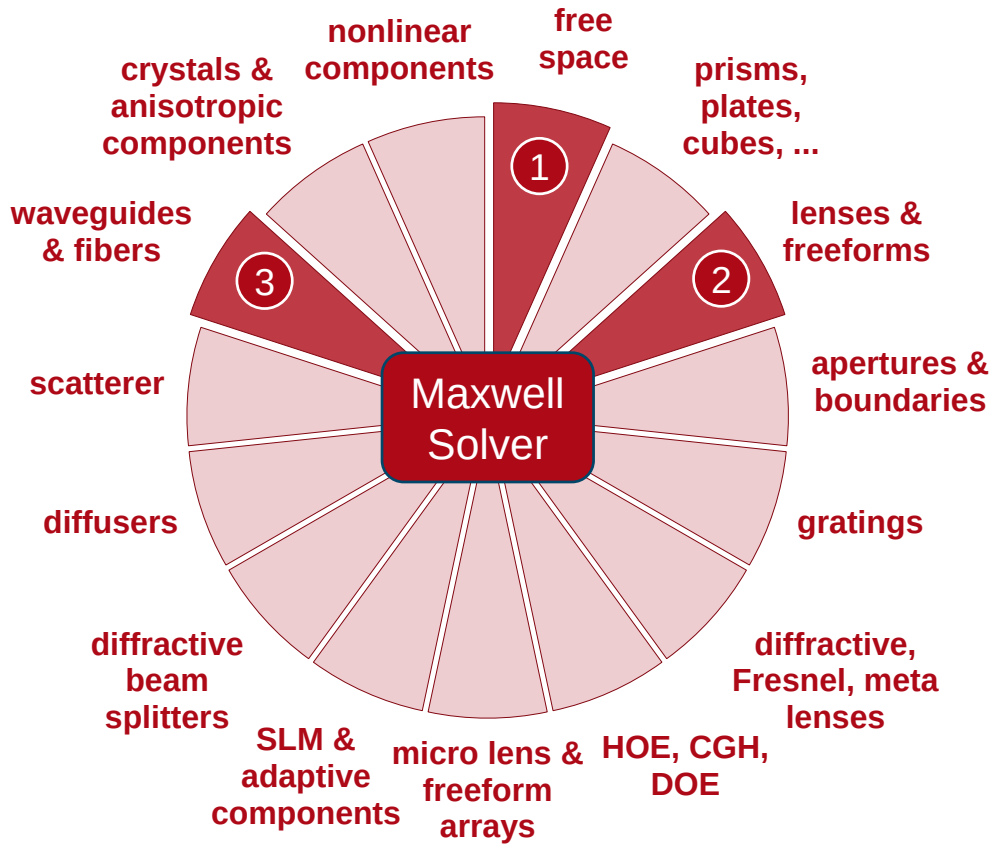
- Set up input Gaussian field
  - Basic Source Models
- Load fiber coupling lens e.g. from Zemax file
  - Import Optical Systems from Zemax
  - Optimal Working Distance for Coupling Light into Single-Mode Fibers

  or optimize your own lens in VirtualLab
  - Parametric Optimization of Fiber Coupling Lenses
- Use Parameter Run to scan over tolerance factors of concern



VirtualLab Technologies





Document Information

title	Tolerance Analysis of a Fiber Coupling Setup
document code	FCP.0004
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	7.4.0.49
category	Application Use Case
further reading	- Comparison of Different Lenses for Fiber Coupling - Parametric Optimization of Fiber Coupling Lens