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LP Fiber Mode Calculator
The Fiber Mode Calculator can be used to calculate linearly polarized (LP) propagation modes in a cylindrically symmetric fiber, either step-index with a single core or graded-index with an infinite parabolic profile. The corresponding polynomials to describe these modes are Bessel for step-index fibers and Laguerre for graded-index fibers. This use case shows how to use the calculator and the configuration of the sampling parameters of mode fields.
Configuring the Fiber Structure: Step-Index Fiber

Modes in step-index fiber are mainly based on Bessel polynomials.

The refractive index $n_{\text{core}}$ corresponds to that of the core material.

The refractive index $n_{\text{cladding}}$ is that of the cladding material.

The number of propagating modes is limited by the structure of the step-index fiber. Users can manually truncate number of modes.

$2\rho_0$ is core diameter.
Setting of the Fiber Structure: Graded-Index Fiber

The number of orders can be selected by user.

Setting of the Fiber Structure: Graded-Index Fiber

Modes in this type of graded-index fiber are mainly based on Laguerre polynomials.

refractive index of infinite parabolic profile

\[ n(\rho) = n_{\text{core}} \left[ 1 - 2\Delta \left( \frac{\rho}{\rho_0} \right)^2 \right], \]

with \( \rho = \sqrt{x^2 + y^2} \)

The number of propagating modes is infinite, so users need to truncate the number of orders.

\( \Delta \) is the gradient constant.
Calculation of Propagation Constants

Propagation constant $\beta$ for each mode is calculated on-the-fly.

Effective refractive index $n_{\text{eff}}$ is $n_{\text{eff}} = \frac{\beta}{k_0}$, with $k_0$ the vacuum wave number.
Display of Propagation Constants
Calculation and Display of Propagation Modes

- default sampling parameters
  - window size is $3\rho_0 \times 3\rho_0$
  - sampling number is $151 \times 151$
Peek into VirtualLab Fusion

convenient setting of fiber structure

mode field of a specific fiber
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