

# Aberration Effects on Focused Modes from a Fiber Source

#### Abstract



Fibers are widely used as sources in optical systems. Investigating the aberration effects of an optical system on the propagation of the fiber modes is therefore of interest. In this use case we employ the fast physical optics engine in VirtualLab Fusion to demonstrate how the shape of a set of modes generated by either a step- or graded-index fiber, and the total field resulting from their combination, is affected by propagation through an aberrated optical system.

# Modeling Task with a Step-Index Fiber



#### step-index fiber

- wavelength 600nm
- core diameter 10 um
- n<sub>core</sub> = 1.455
- $n_{cladding} = 1.45$

This calculator gives the propagation constants and mode fields of all existing linearly polarized (LP) modes.

**Linearly Polarized Mode Calculator** 

1: D:\Dokumente\\Aberra	tion Effects on Fiber Modes_Calc	ulator.calc				- • •	
Mode Type	Linearly Polarized Bessel	~	Index Azimuthal Order L	Radial Order M	Propagation Constant β	Effective R	
Wavelength	600 nm		0 0	1	1.5231e+07 m <sup>-1</sup> 1.5208e+07 m <sup>-1</sup>	1.4545 1.4522	
Core Diameter	10 µm		<u>3</u> 1 4 1	1	1.5223e+07 m <sup>-1</sup> 1.5192e+07 m <sup>-1</sup>	1.4536 1.4507	
Core Material			5 2	1	1.5212e+07 m <sup>-1</sup>	1.4526	
Name Non-Dispersive Ma	aterial (n=1.455)	Q	S	1	1.5196e+07 m	14515	4 of 6 ▶
Defined by Constant Refra	active Index V	1.455					Mode L=1, M=2"
State of Matter	Solid	~					.Subset Selection
Cladding Material						22: Mode Fields	
Name Non-Dispersive Material (n=1.45)					Dia	Numeric agram Table Value a	cal Data Array (Equidistant)
Defined by Constant Refractive Index ~ 1.45				Squared Amplitude of "Mode L=1, M=2" [(MV/m) <sup>2</sup> ]			
State of Matter     Solid       Maximum Azimuthal Index     3 🜩       Maximum Radial Index     3 🌩						۲ (۲m) ۲۰۰۵	29.408
Output of Additional Data Arrays  Create Mode Fields  Show Mode Structure			/			φ.	
Validity: 🚹 🚺					Close	-5	0 5 X [µm]
					J		
For further information:						fields o	f all LP modes
LP Fiber Mode Calculator							

### **Source of Fiber Modes**



irradiance of existing LP modes in the step-index fiber

## **Diffraction Patterns**



Setup concept from Appl. Opt. 59,6584-6592 (2020)

# Switch from Single Mode Source to Multiple Light Source



Setup concept from Appl. Opt. 59,6584-6592 (2020)

# Switch from Single Mode Source to Multiple Light Source



# **Modeling Task with a Graded-Index Fiber**



# **Source Modes and Diffraction Patterns**



of modes

# **VirtualLab Fusion Technologies**



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further reading	<ul> <li>Fiber Mode Calculator</li> <li>Few-Mode Fiber Coupling under Atmospheric Turbulence</li> </ul>		