Comparison of Different Lenses for Fiber Coupling
Optical fibers are widely used in different applications, and they play an important role in long-distance optical communication. In practice, launching light into optical fibers, especially to single-mode ones, can be a challenging task and the fiber coupling lens must be carefully chosen. In this example, we select two commercially available lenses, with the same effective focal length, but different surface types. They are evaluated, for the task of coupling light into a single-mode fiber, in terms of coupling efficiency which is calculated by using the overlap integral.
When two lenses with the same effective focal length are available for fiber coupling task, how to evaluate their performance in terms of coupling efficiency?
Due to aberrations from the spherical lens, the focal spot at the end of the fiber deviates from a Gaussian mode, and therefore it leads to poor coupling efficiency.
Simulation Results

Aspherical lens controls the aberrations well and that guarantees a focal spot in smaller size, and with Gaussian profile that fits to the fiber.

Edmund 64802 (aspherical lens)
- effective focal length 2 mm

Coupling efficiency $\eta_1 = 99.98\%$
(overlap integral calculation)

Input field
- fundamental Gaussian
- wavelength 780 nm
- diameter 660 µm

Intensity $[1 \times 10^4 \text{ (V/m)}^2]$
Peak into VirtualLab Fusion

- Imported lens from Zemax file
- Visualization and analysis
Workflow in VirtualLab Fusion

- Set up input Gaussian field
  - Basic Source Models [Tutorial Video]
- Load different coupling lenses from Zemax files
  - Import Optical Systems from Zemax [Use Case]
- Find optimal working distances for different lenses
  - Optimal Working Distance for Coupling Light into Single-Mode Fibers [Use Case]
and then compare their performance
VirtualLab Fusion Technologies

Edmund 64802
(aspherical lens)
- effective focal length 2 mm

Field Solver

1. free space
2. lenses & freeforms
3. grating, apertures & boundaries
4. HOE, CGH, DOE
5. diffractive, Fresnel, meta lenses
6. waveguides & fibers
7. scatterer
8. diffractive beam splitters
9. SLM & adaptive components
10. micro lens & freeform arrays
11. crystals & anisotropic components
12. nonlinear components
13. prisms, plates, cubes, ...

1. single-mode fiber
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| further reading | - [Optimal Working Distance for Coupling Light into Single-Mode Fibers](#)  
- [Parametric Optimization of Fiber Coupling Lens](#) |