Focal Spots for Different Aberrations
Abstract

Different wavefront aberrations have different influences on the focal spot distribution. It is therefore crucial to investigate such effects in e.g. imaging systems. In VirtualLab Fusion, different wavefront aberrations can be generated and their effects on the focal spot distribution can be studied conveniently. As examples, we select several typical aberrations (spherical, coma, astigmatism, ...), vary their values, and calculate the corresponding focal spot distributions.
Modeling Task

- input spherical wave with different aberration
  - wavelength @ 532nm
  - type of aberration:
    1. defocus
    2. spherical
    3. astigmatism
    4. coma
    5. secondary coma
    6. trefoil

What is focal spot distribution for different aberration?
Defocus

- **no aberration**
- **defocus = 0.2\(\lambda\)**
- **defocus = 0.5\(\lambda\)**

Wavefront error @ input plane

Focal spot
Spherical Aberration

Wavefront error @ input plane

Focal spot

No aberration
Spherical = 0.2\(\lambda\)
Spherical = 0.5\(\lambda\)
Astigmatism

no aberration

wavefront error @input plane

focal spot

astigmatism = 0.2\lambda

astigmatism = 0.5\lambda
Coma

wavefront error @input plane

focal spot
Secondary Coma

- No aberration
- Secondary coma = 0.2\(\lambda\)
- Secondary coma = 0.5\(\lambda\)

Wavefront error @ input plane

Focal spot
Trefoil

wavefront error @ input plane

focal spot

no aberration
trefoil = 0.2λ
trefoil = 0.5λ

Data for Wavelength of 532 nm  [1E7 (V/m)^2]
Peek into VirtualLab Fusion

- Customizable wavefront aberrations
- Fast calculation and flexible visualization of focal spot
- Visualization of wavefront error
VirtualLab Fusion Technologies

- Prisms, plates, cubes, ...
- Lenses & freeforms
- Apertures & boundaries
- Gratings
- Diffractive, Fresnel, meta lenses
- HOE, CGH, DOE
- Micro lens & freeform arrays
- SLM & adaptive components
- Diffractive beam splitters
- Scatterer
- Waveguides & fibers
- Nonlinear components
- Free space
- Crystals & anisotropic components
- Field Solver

Diagram dimensions: 5mm height, 10mm width.
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| further reading       | - Advanced PSF & MTF Calculation for System with Rectangular Aperture  
                        | - Simulation of Laser Beam in Focal Region of High-NA Asphere       |