Laser Beam “Clean-Up” with Spatial Filter
To obtain good beam quality is important for many laser applications, and a typical experimental method to obtain good beam quality is the spatial filtering. Within a spatial filtering system, a pinhole is placed on the intermediate focal plane (i.e. the Fourier plane) to get rid of the unwanted spatial frequency components. To model such systems, one must consider the diffraction from the pinhole and the diffraction property of the laser beams, and we demonstrate the spatial filtering effect in this example.
Modeling Task

How does the size of the pinhole, located at the intermediate focal plane, influence the output beam?
Spatial Filter with 7.5µm-Diameter Opening

A relatively large pinhole does not filter out much noise on the Fourier plane.
Spatial Filter with 7.5μm-Diameter Opening

[Diagram showing the setup with input field, pinhole, lenses, and output field.]
Spatial Filter with 5.0µm-Diameter Opening

input field

behind pinhole

in front of pinhole

pinhole
5.0µm diameter

lens #1

output field

lens #2
Spatial Filter with 2.5µm-Diameter Opening

input field

2.5µm diameter

lens #1

pinhole

2.5µm diameter

lens #2

behind pinhole

in front of pinhole

output field
Spatial filter in the Fourier plane helps reduce the higher-frequency noise, therefore leads to better output beam profiles.
Output Beam Profile and Power Comparison

Relatively small pinhole limits the transmitted light and, as a consequence, leads to relatively large loss of power.
 Peek into VirtualLab Fusion

flexible consideration of diffraction via Fourier transform settings

real lens modeling for laser beams
Workflow in VirtualLab Fusion

• Set up input Gaussian field
  – Basic Source Models [Tutorial Video]

• Import lens systems from Zemax OpticStudio®
  – Import Optical Systems from Zemax [Use Case]

• Set the position and orientation of components
  – LPD II: Position and Orientation [Tutorial Video]

• Set the Fourier transforms properly
VirtualLab Fusion Technologies

Free space prisms, plates, cubes, ...

Lenses & freeforms

Gratings
diffractive, Fresnel, meta lenses
HOE, CGH, DOE

Micro lens & freeform arrays
SLM & adaptive components
diffractive beam splitters
Waveguides & fibers
Scatterer
diffusers
Nonlinear components
Crystals & anisotropic components

# idealized component
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| further reading | - Pinhole Modeling in a Low-Fresnel-Number System  
- Automatic Selection of Fourier Transform Techniques in Free-Space Propagation Operator |