Performance Evaluation of an F-Theta Scanning Lens
F-Theta lenses are typically designed to provide high performance in laser scanning systems. With such lenses, the focused spot displacement on the target plane is proportional to the produce of focal length and scan angle. That makes them standard lenses for galvo-scanner-based laser material processing systems. With the help of the scanning source in VirtualLab Fusion, we analyze the performance of a given F-Theta lens, by measuring the deviation between actual spot position and desired value and the spot size for different angles.
The F-Theta lens is supposed to focus the input light with different angle into different spot position, following the relation $h = f_{\text{eff}} \theta$. However, there is no perfect F-Theta system. How to evaluate the actual performance $(h - f_{\text{eff}} \theta)$ for a given F-Theta lens?
Performance Evaluation

input plane wave
- wavelength 488 nm
- scanning angle 0-30°
- beam diameter 4 mm

spot diameter (FWHM)

<table>
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<tr>
<th>angle</th>
<th>diameter (x)</th>
<th>diameter (y)</th>
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<tr>
<td>0°</td>
<td>12.4 µm</td>
<td>12.4 µm</td>
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<tr>
<td>15°</td>
<td>12.7 µm</td>
<td>12.5 µm</td>
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<td>30°</td>
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Performance Evaluation

- input plane wave
  - wavelength 488 nm
  - scanning angle 0-30°
  - beam diameter 4 mm

Deviation between actual and the desired focal spot position indicates the performance of the F-Theta lens.

Animation showing spot variation during scanning process
VirtualLab Fusion Technologies

1. Free space prisms, plates, cubes, ...
2. Lenses & freeforms
3. Apertures & boundaries
4. Gratings
5. Diffractive, Fresnel, meta lenses
6. HOE, CGH, DOE
7. Micro lens & freeform arrays
8. SLM & adaptive components
9. Crystals & anisotropic components
10. Waveguides & fibers
11. Scatterer
12. Diffusers
13. Diffractive beam splitters
14. Waveguides & fibers
15. Nonlinear components

Virtual channels:
- Source
- Detector
- Channels
- $V_{in}^{in}(\rho)$
- $V_{out}^{out}(\rho)$
- $\mathcal{F}_k$
- $\mathcal{F}_k^{-1}$
- $\mathcal{F}_k$
- $\mathcal{F}_k^{-1}$
- $\mathcal{F}_k$
- $\mathcal{F}_k^{-1}$
Peek in VirtualLab Fusion

scanning source configuration

lens system construction

analysis of deviation between actual and the desired focal spot position
Performance Evaluation of An F-Theta Scanning Lens

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<td>- Performance Analysis of Laser Scanning System</td>
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