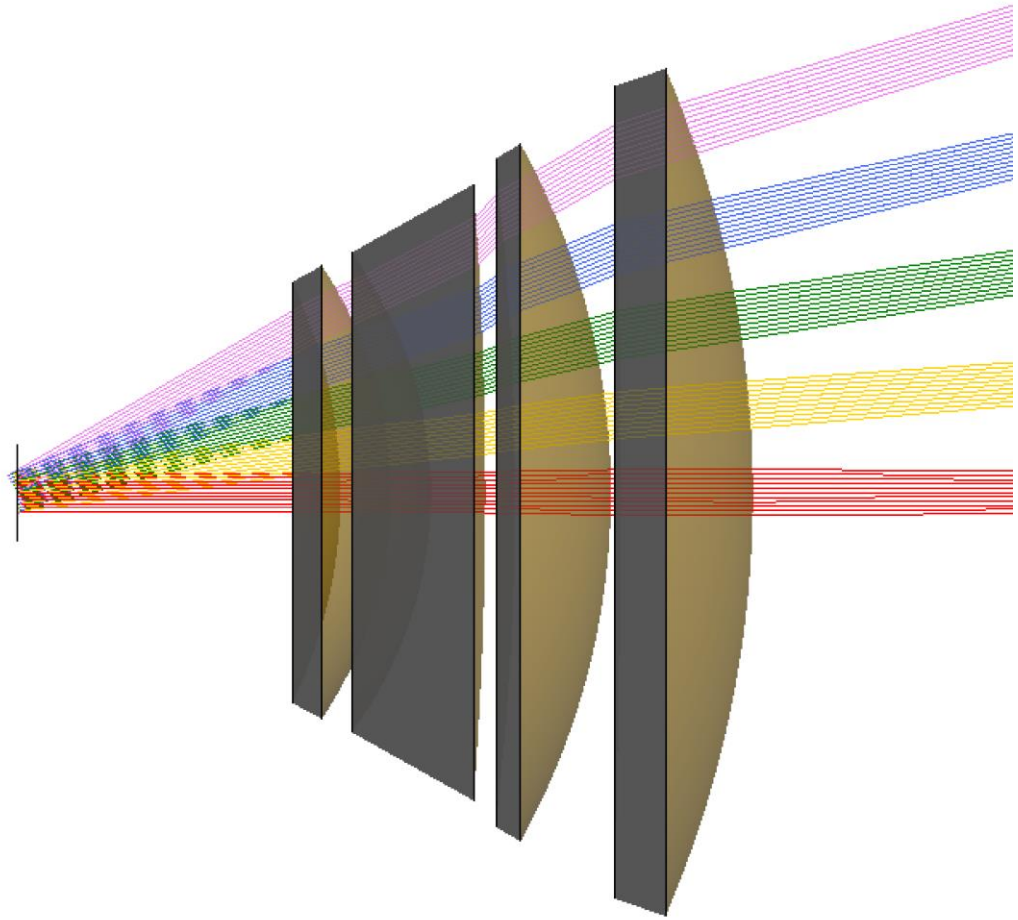
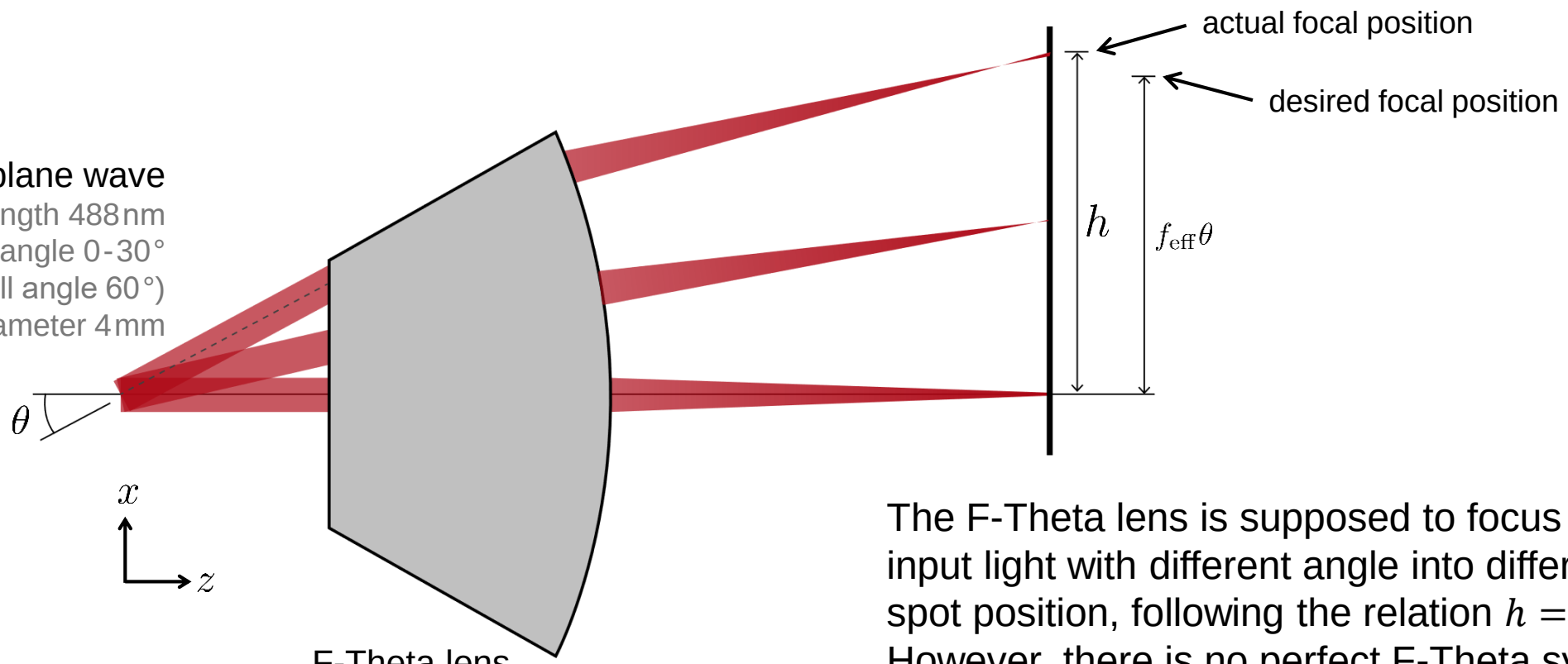
Performance Evaluation of an F-Theta Scanning Lens

Abstract



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, 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.

Modeling Task

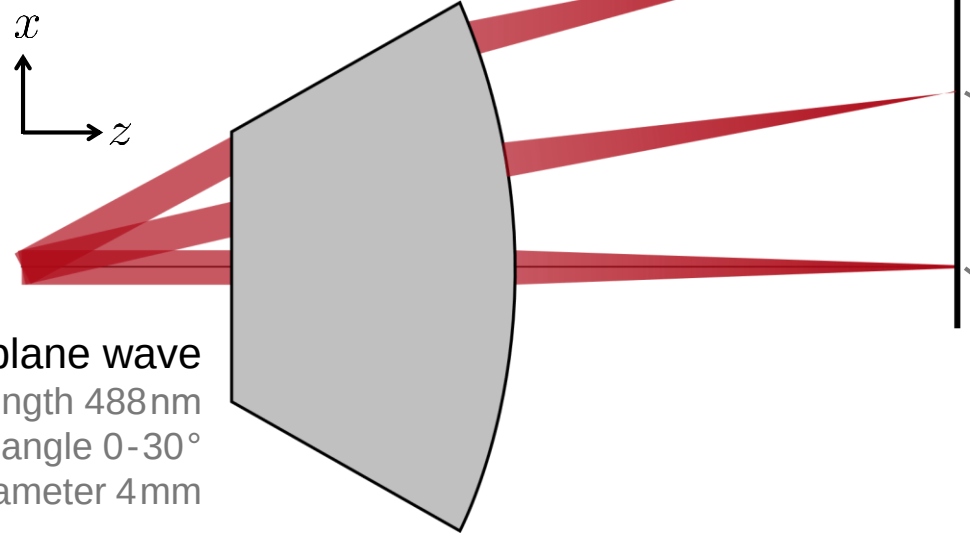


input plane wave
- wavelength 488 nm
- scanning angle 0-30° (full angle 60°)
- beam diameter 4 mm

F-Theta lens
- effective focal length f_{eff} = 100.18 mm
- from patent USP 4436383

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



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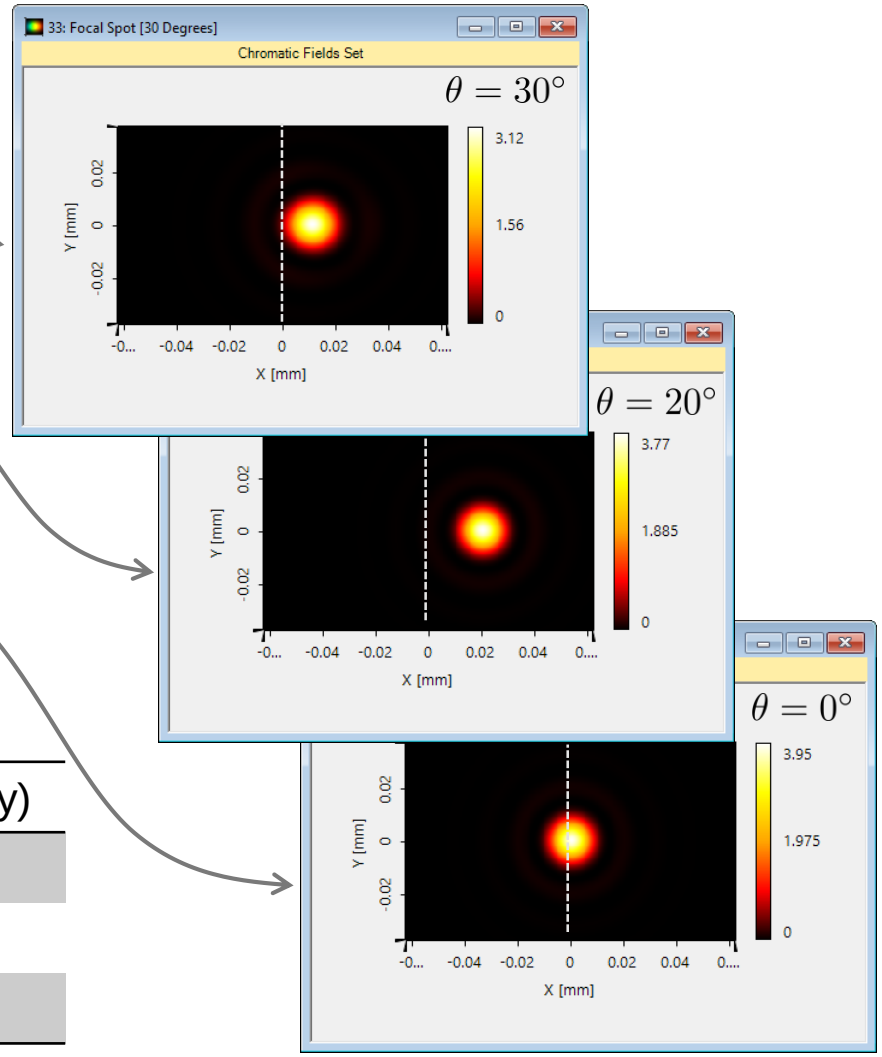
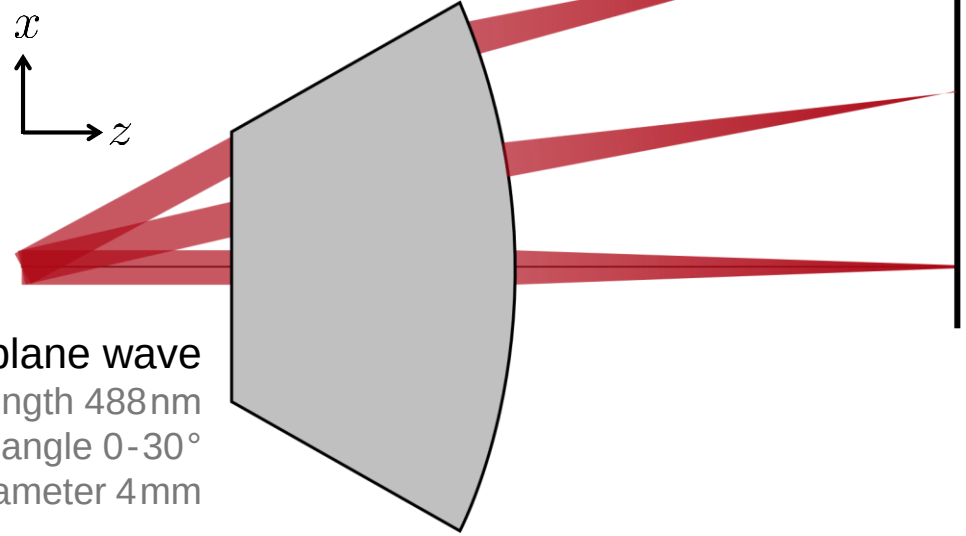


spot diameter (FWHM)

angle	diameter (x)	diameter (y)
0°	12.4 µm	12.4 µm
15°	12.7 µm	12.5 µm
30°	14.0 µm	12.9 µm

Performance Evaluation



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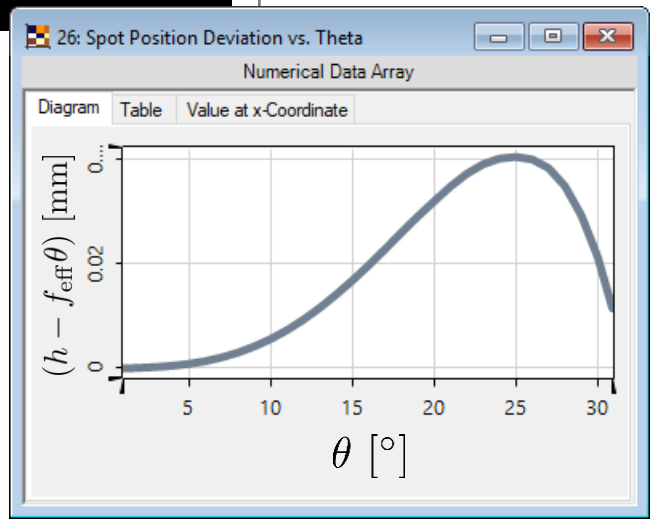
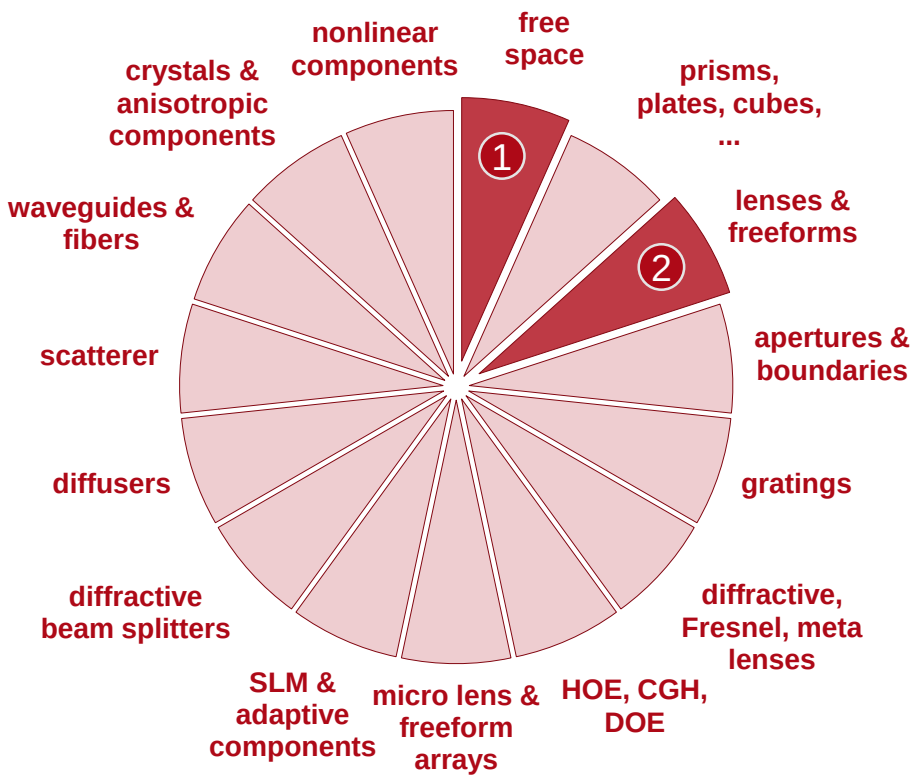
animation showing spot variation during scanning process

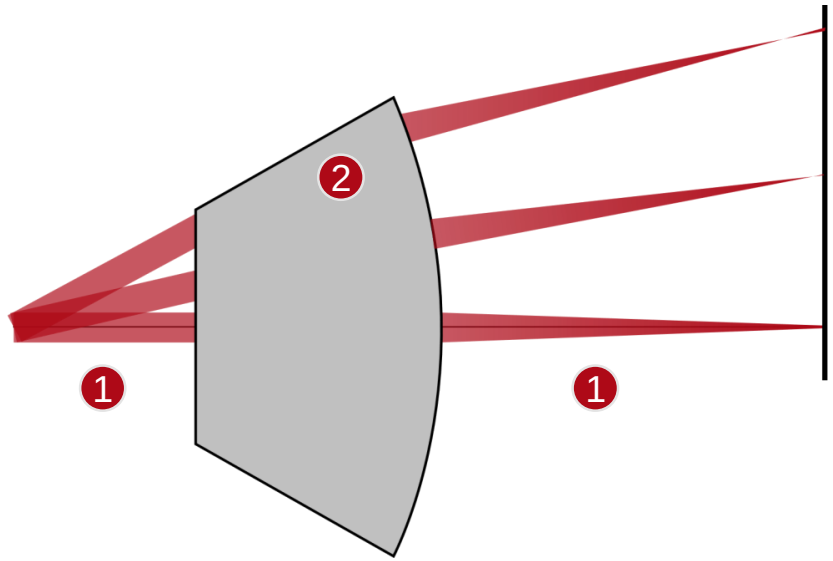
centered at $f_{\mathrm{eff}}\theta$

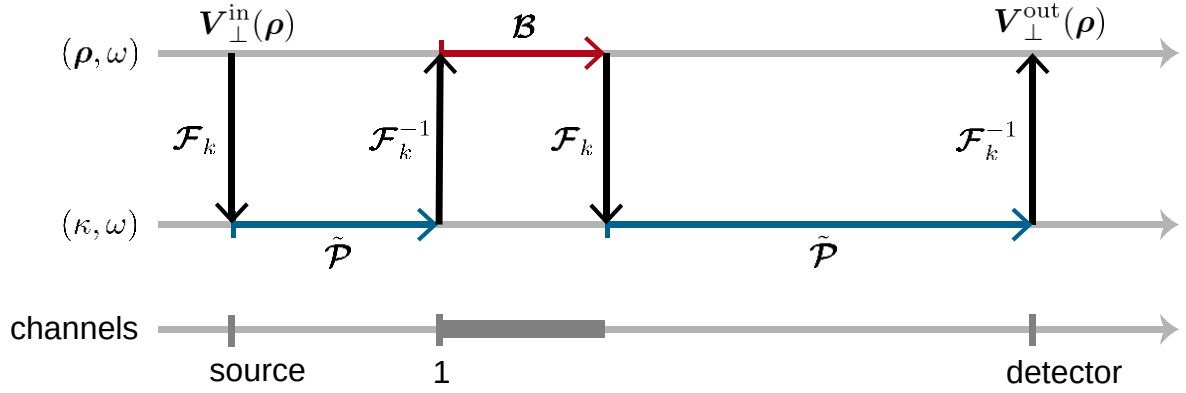


Deviation between actual and the desired focal spot position indicates the performance of the F-Theta lens.

VirtualLab Technologies

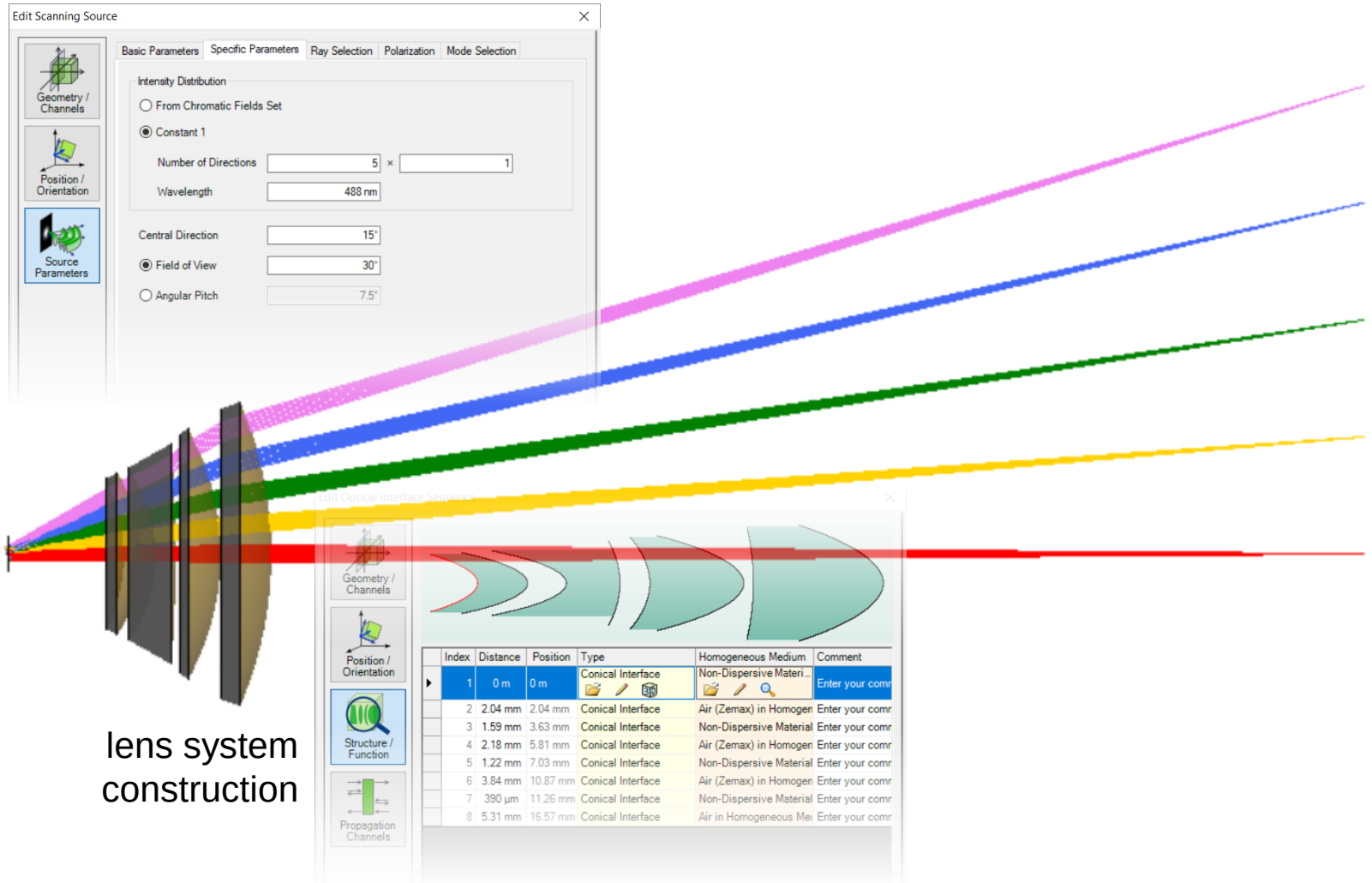




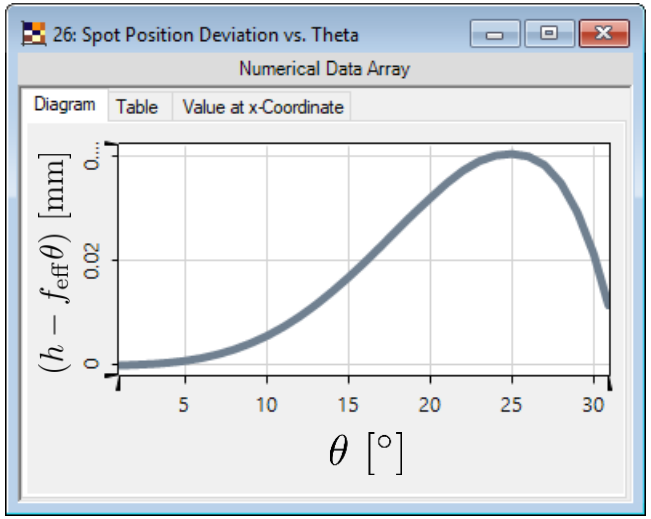


Peek in VirtualLab

scanning source configuration



lens system construction



analysis of deviation between actual and the desired focal spot position

Document Information

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VL version used for simulations	7.4.0.48
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