

Feature.0018

## Usage of Distortion Analyzer

Precise analysis of distortion aberration of a lens component. The plotting of distortion versus angles can be obtained easily. It is very helpful for designing lenses and take the field distortion during a parametric optimization into account.

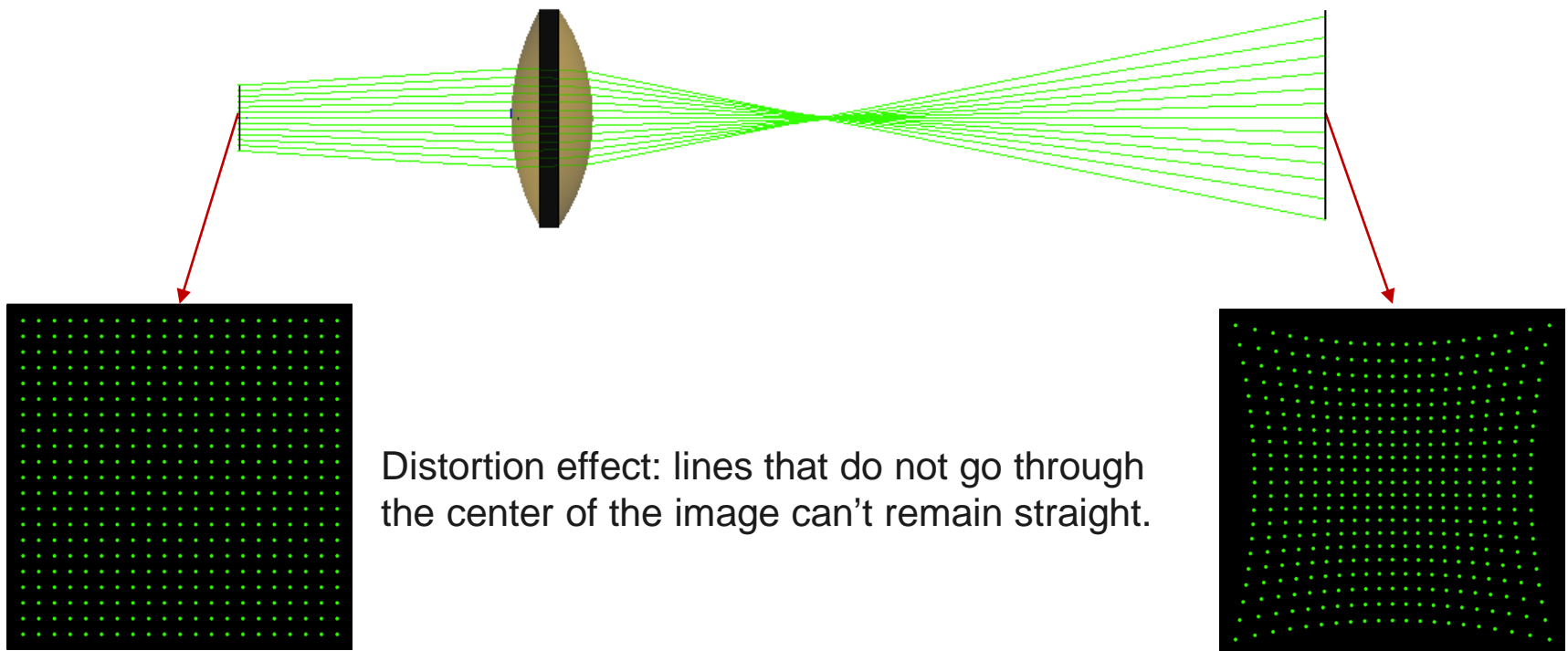
# About This Use Case

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- The following toolbox is required:
  - Starter toolbox
- This use case is created by using VirtualLab Fusion (Build 7.0.0.35).
- Get your free Trial Version [here!](#)

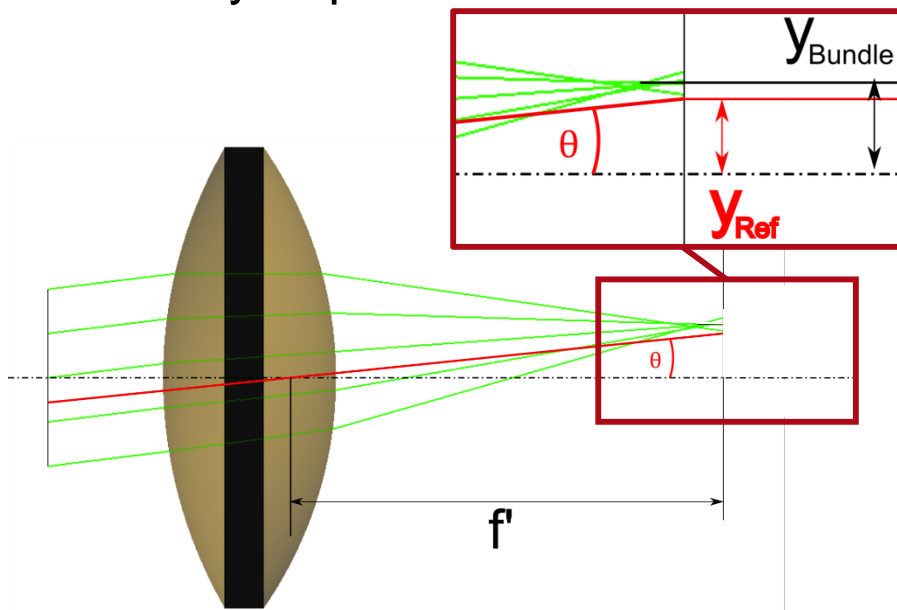
# This Use Case Shows ...

- definition of distortion aberration.
- setting of the distortion analyzer in VirtualLab.
- example: distortion of a spherical lens.



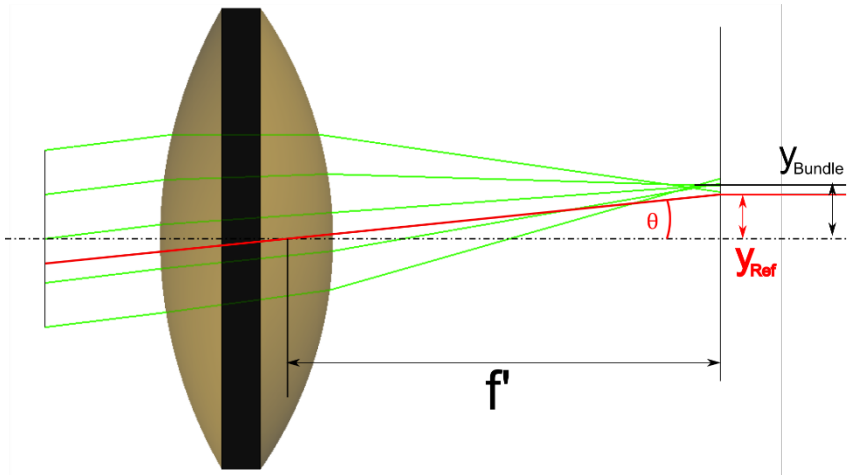
# Definition of Distortion

- Distortion corresponds to spherical aberration of the chief ray. It is defined as the deviation of the lateral position of the ray bundle to a reference position at the focal plane.
- Using the effective focal length ( $f'$ ) of the scanning lens, one can calculate the position of reference ray at the focal plane, which mainly depends on the incidence angle.



- $f'$ : effective focal length
- $\theta$ : incidence angle
- $y_{\text{Bundle}}$ : lateral position of ray bundle
- $y_{\text{Ref}}$ : lateral position of reference ray

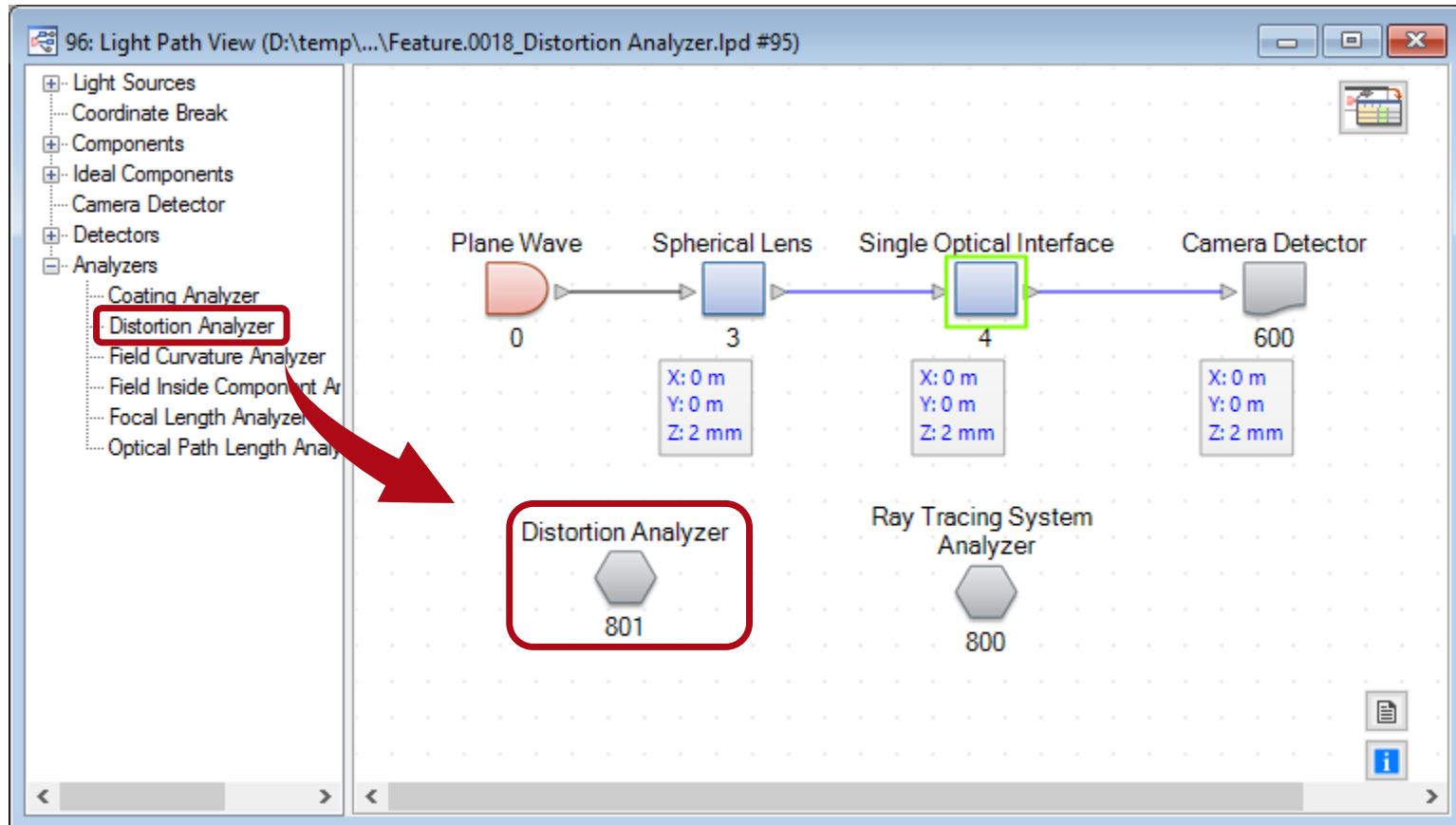
# Definition of Distortion



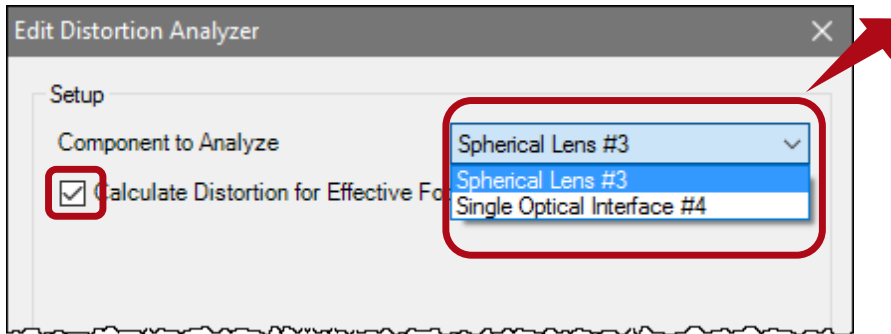
$$\text{Distortion} = \frac{y_{\text{Bundle}} - y_{\text{Ref}}}{y_{\text{Ref}}}$$

- F-Tan(Theta) distortion:  $y_{\text{Ref}} = f' \cdot \tan(\theta)$
- F-Theta distortion:  $y_{\text{Ref}} = f' \cdot \theta$
- Ray bundle position ( $y_{\text{Bundle}}$ ):
  - Chief ray: the position of the chief ray is used
  - Centroid: physically relevant is the energy centroid

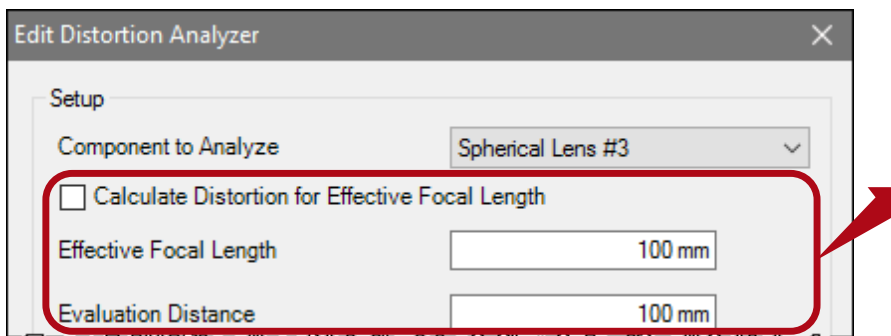
# Distortion Analyzer in VLF



# Setting of the Analyzer

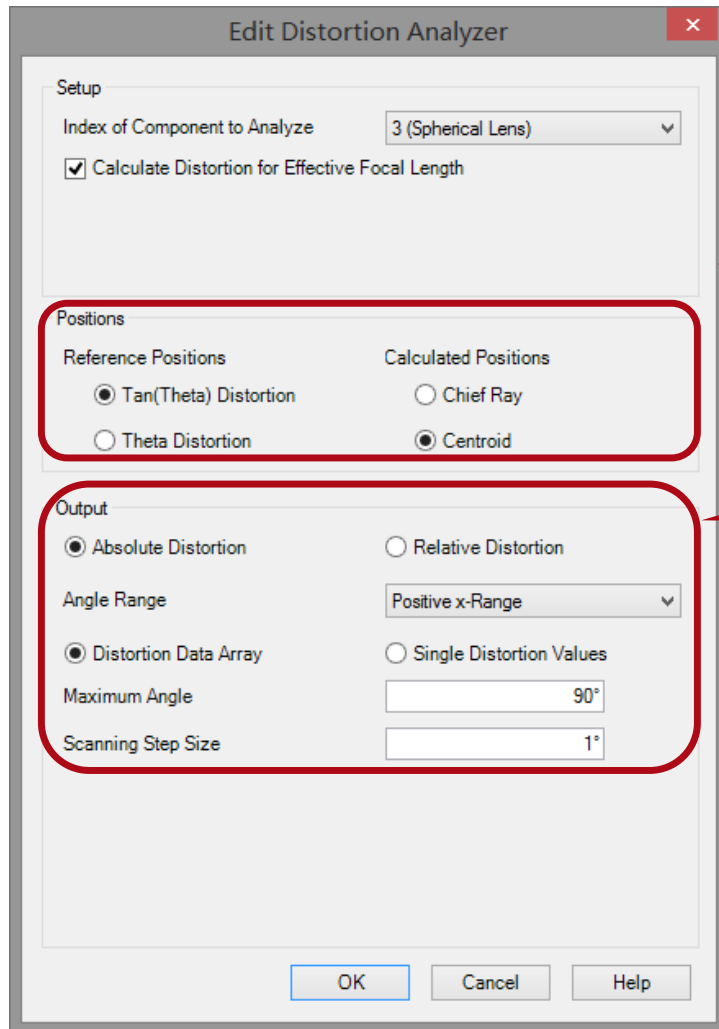


or



- Select a lens component to be analyzed. The analysis is independent of the system.
- Check the option to set the detector plane at effective focal length
- Determine the *Evaluation Distance* by the user's requirement.

# Setting of the Analyzer



- Positions (distortion type)
  - Reference position
  - Calculated ray bundle position
- Output (Result display)
  - *Absolute Distortion* ([m]) or *Relative Distortion* ([%])
  - *Angle Range*: 4 scan options (x, y, -x, -y)
  - *Distortion Data Array* or *Single Distortion Values*



# Distortion of Spherical Lens

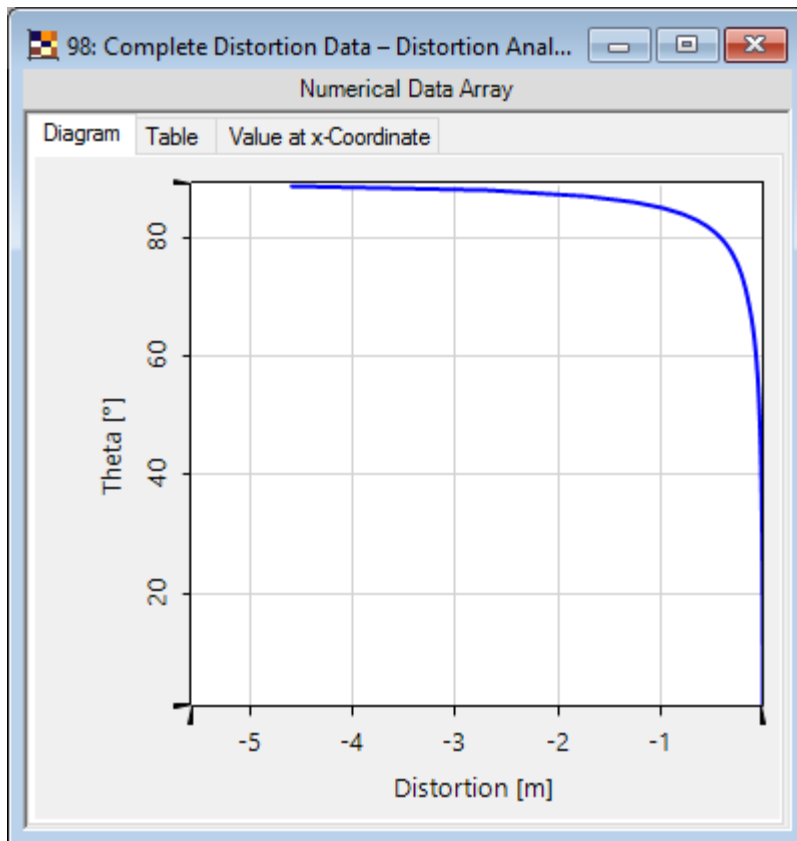
The image displays two windows from a ray tracing software interface. The top window, titled "96: Light Path View", shows a schematic of an optical system. It consists of four main components connected in a sequence: a Plane Wave (index 0), a Spherical Lens (index 3), a Single Optical Interface (index 4), and a Camera Detector (index 600). Each component has associated coordinate information: X: 0 m, Y: 0 m, and Z: 2 mm. Below the main sequence, there are two analyzer components: a Distortion Analyzer (index 801) and a Ray Tracing System Analyzer (index 800). The bottom window, titled "95: Light Path Editor", provides a detailed view of the system's configuration. It features a toolbar with icons for Path, Detectors, Analyzers, and Logging. Below the toolbar is a table listing the elements and their connections.

Start Element				Target Element		Linkage	
Index	Type	Channel	Medium	Index	Type	Propagation Method	On/Off
0	Plane Wave	-	Air in Homogeneous Medi...	3	Spherical Lens	Automatic Propagation Operator	On
3	Spherical Lens	T	Air in Homogeneous Medi...	4	Single Optical Interface	Automatic Propagation Operator	On
4	Single Optical Interface	T	N-BK7_Schott_2015 in Ho...				

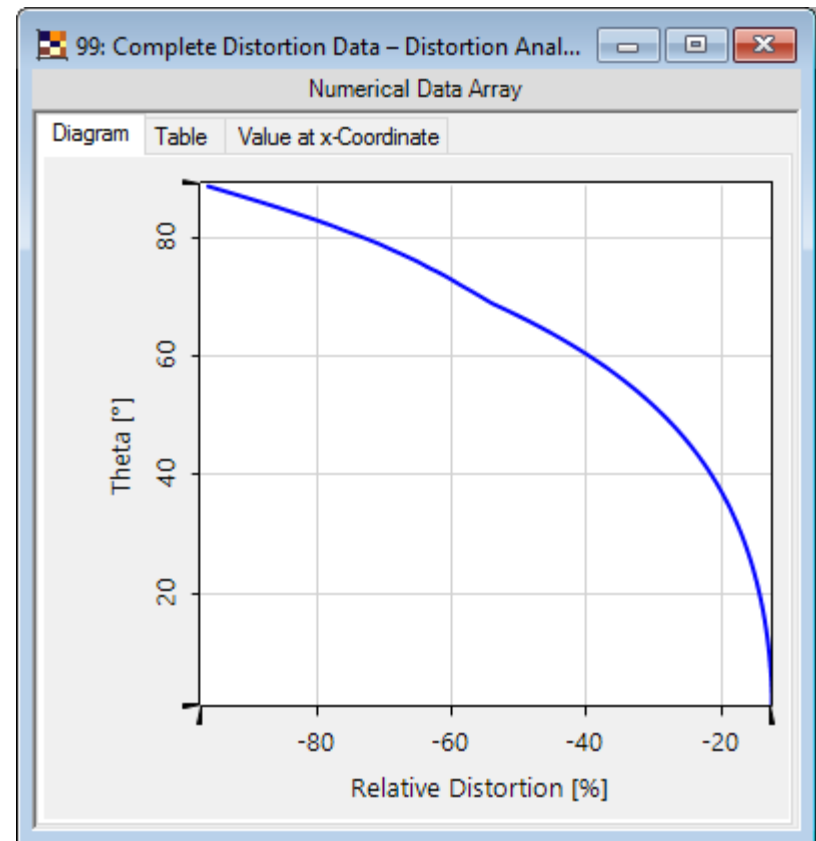
At the bottom of the Light Path Editor window, the "Simulation Engine" dropdown menu is set to "801: Distortion Analyzer", and a red hand icon points to the "Go!" button.

# Distortion of Spherical Lens

## Absolute Distortion Result



## Relative Distortion Result



# Document & Technical Info

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