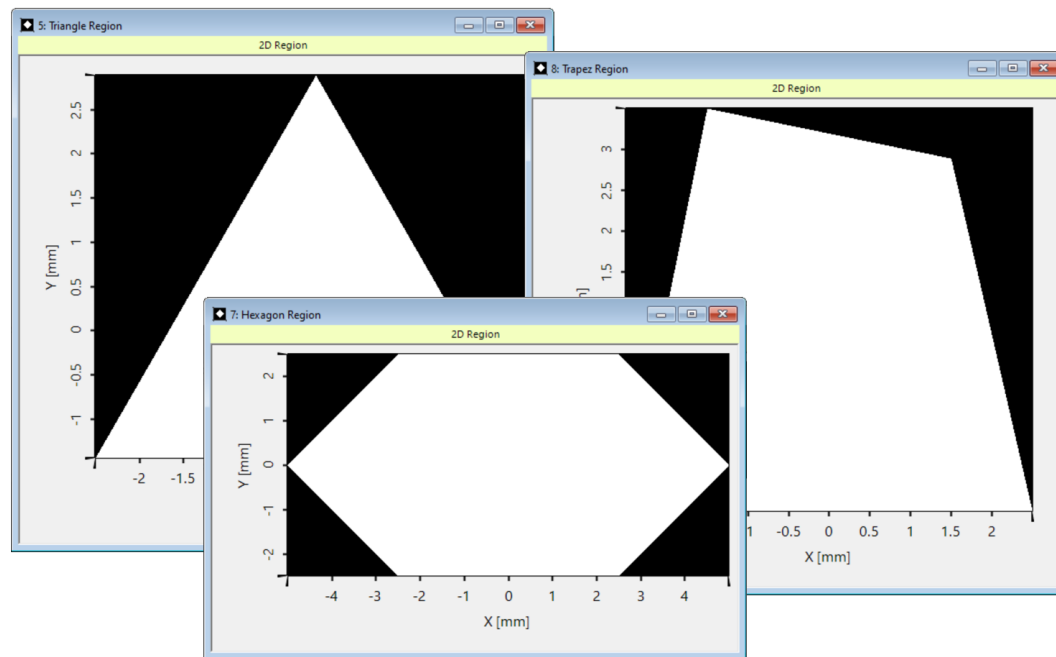


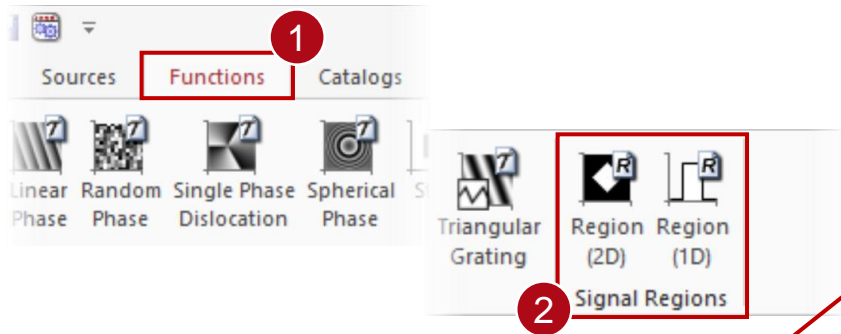
Flexible Region Definition

Abstract

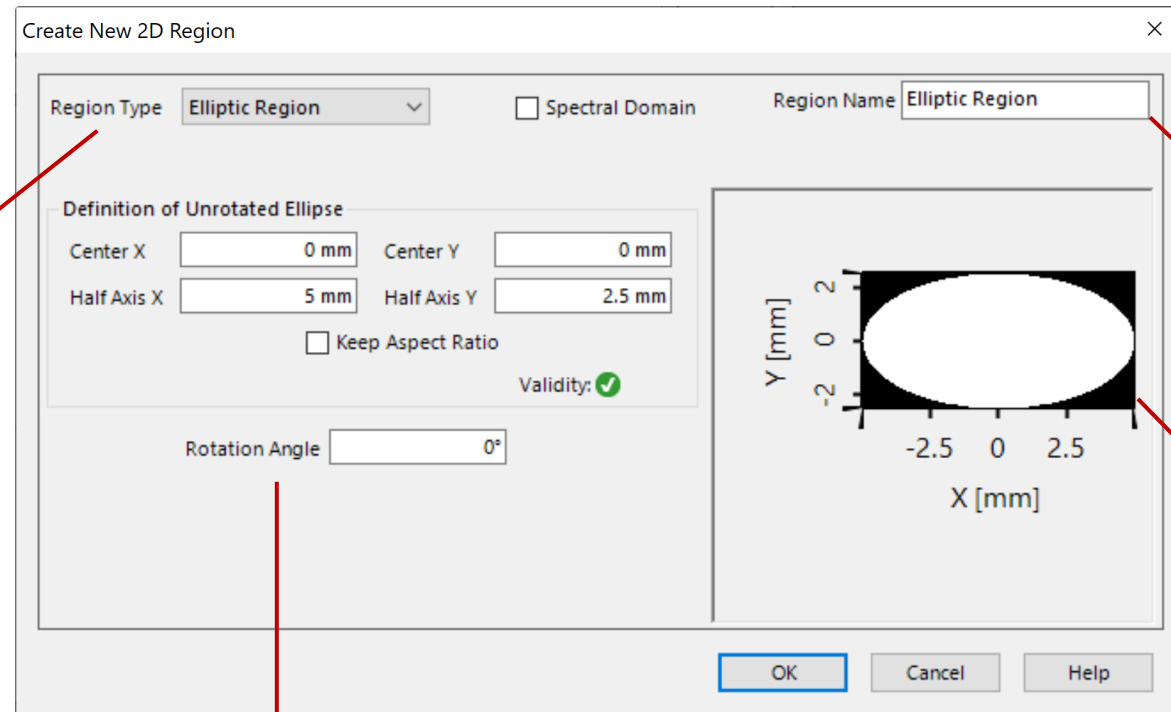


In VirtualLab Fusion, the concept of “region” (understood as a finite area defined on a plane, occasionally also 1D) is used for several purposes across the software: to determine the desired optimization region for the IFTA or the evaluation area for the Diffractive Optics Merit Functions detector, but also to define grating regions on the surfaces of light guides to perform the function, for instance, of couplers. To cover all of the above without restricting our users, the configuration of regions in VirtualLab Fusion is extremely flexible, with several off-the-shelf options as well as importing capabilities. In this use case we go over the process of region configuration in detail.

Region Definition



There are multiple different templates for new regions.



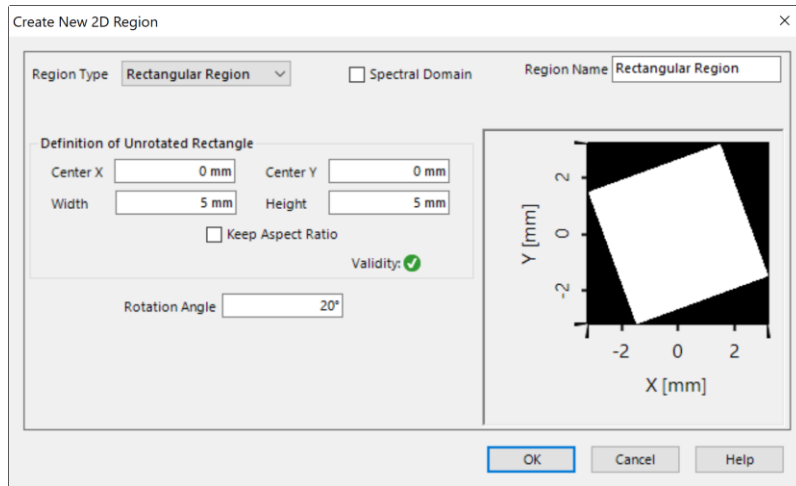
The actual parameters of the region

Name of the region (editable)

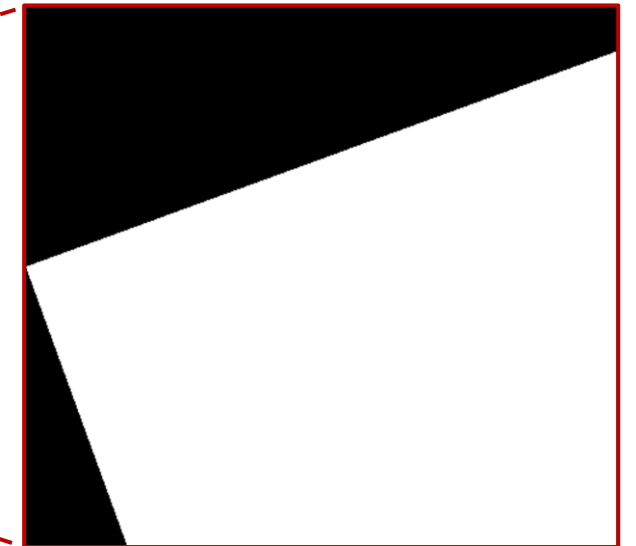
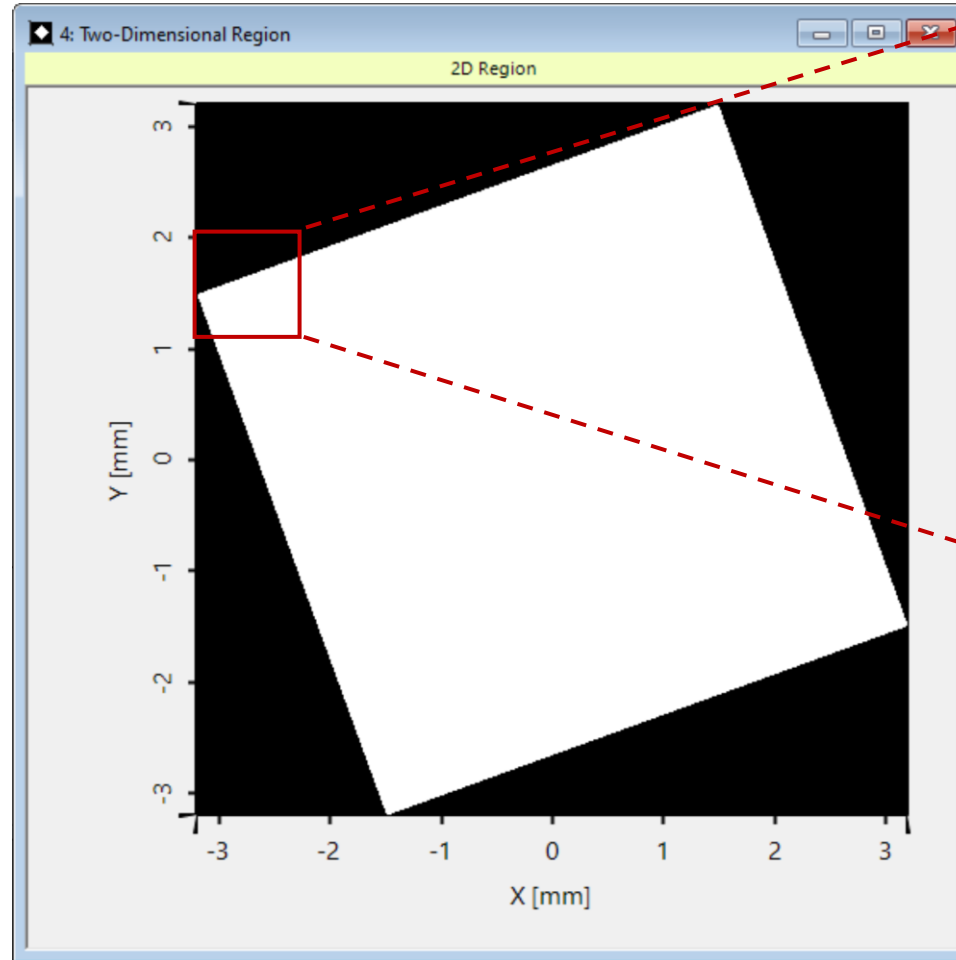
A preview according to the current settings is displayed here.

Note: In the Light Guide component it is possible to generate and configure the regions directly in the component itself.

Simple Regions



Simple rectangular and elliptical regions can be directly defined from the template.



Rectangular, elliptical and polygonal regions are defined analytically through their parameters, and can thus be zoomed arbitrarily without pixelation. But they also can be converted to sampled data instead.

Polygon Regions

Create New 2D Region

Region Type: Simple Polygon Region ☐ Spectral Domain Region Name: Polygon Region

Polygon Vertices

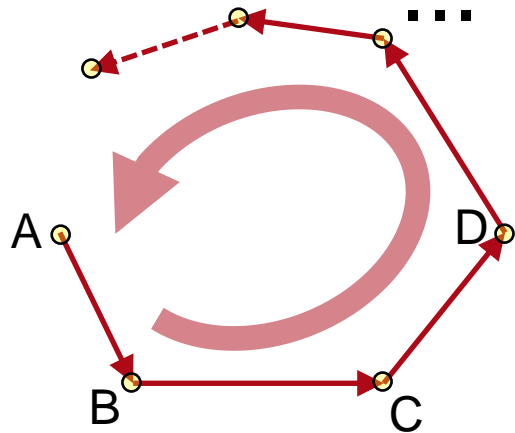
Name	x-Coordinate	y-Coordinate
A	-2.5 mm	-1.443375673 mm
B	2.5 mm	-1.443375673 mm
C	0 mm	2.886751346 mm

Append New
Insert New
Remove
Move Up
Move Down

Validity:

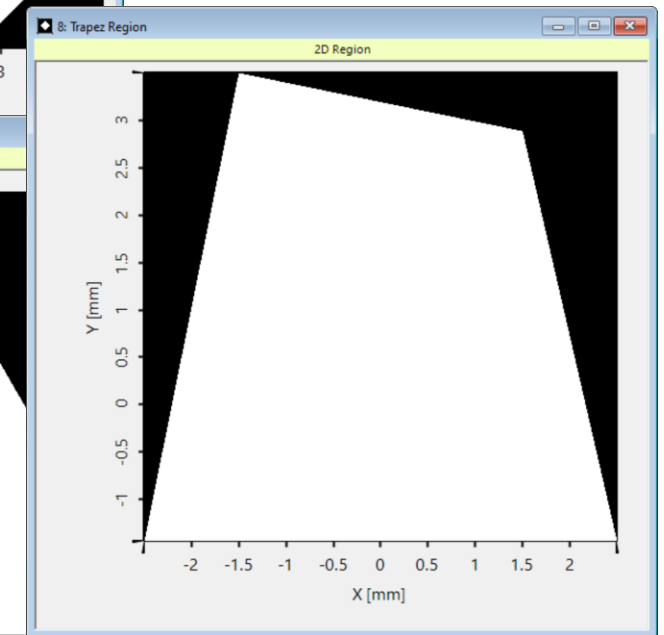
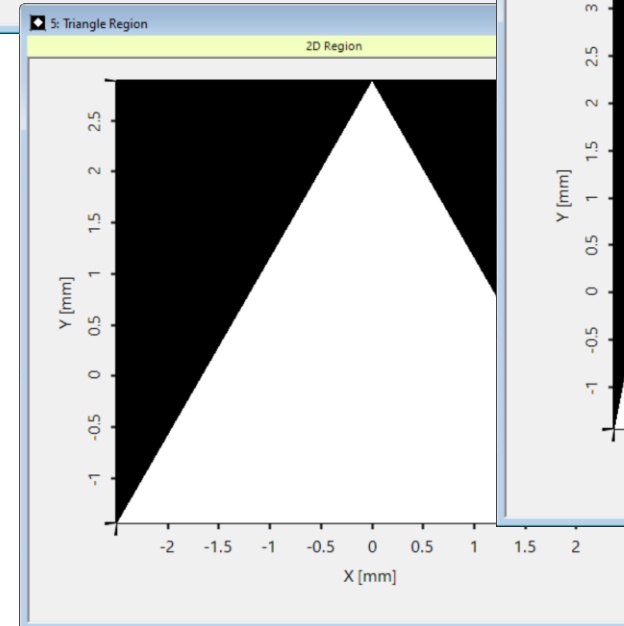
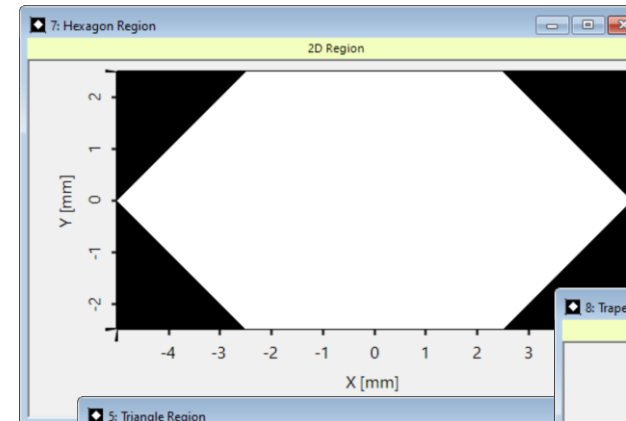
OK Cancel Help

counterclockwise
definition

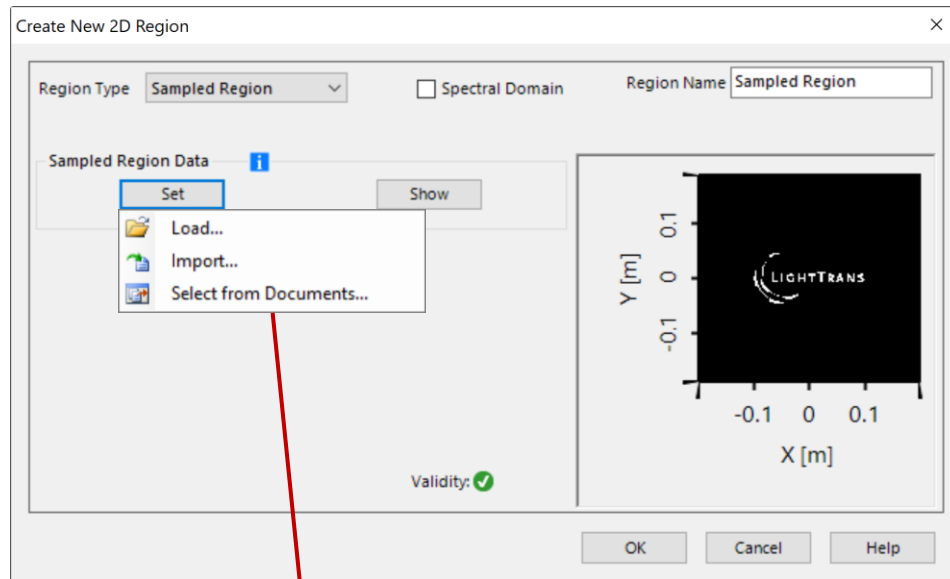


Type in positions of polygon vertices in successive sequence to construct simple polygon regions. Vertices are defined counter-clockwise.

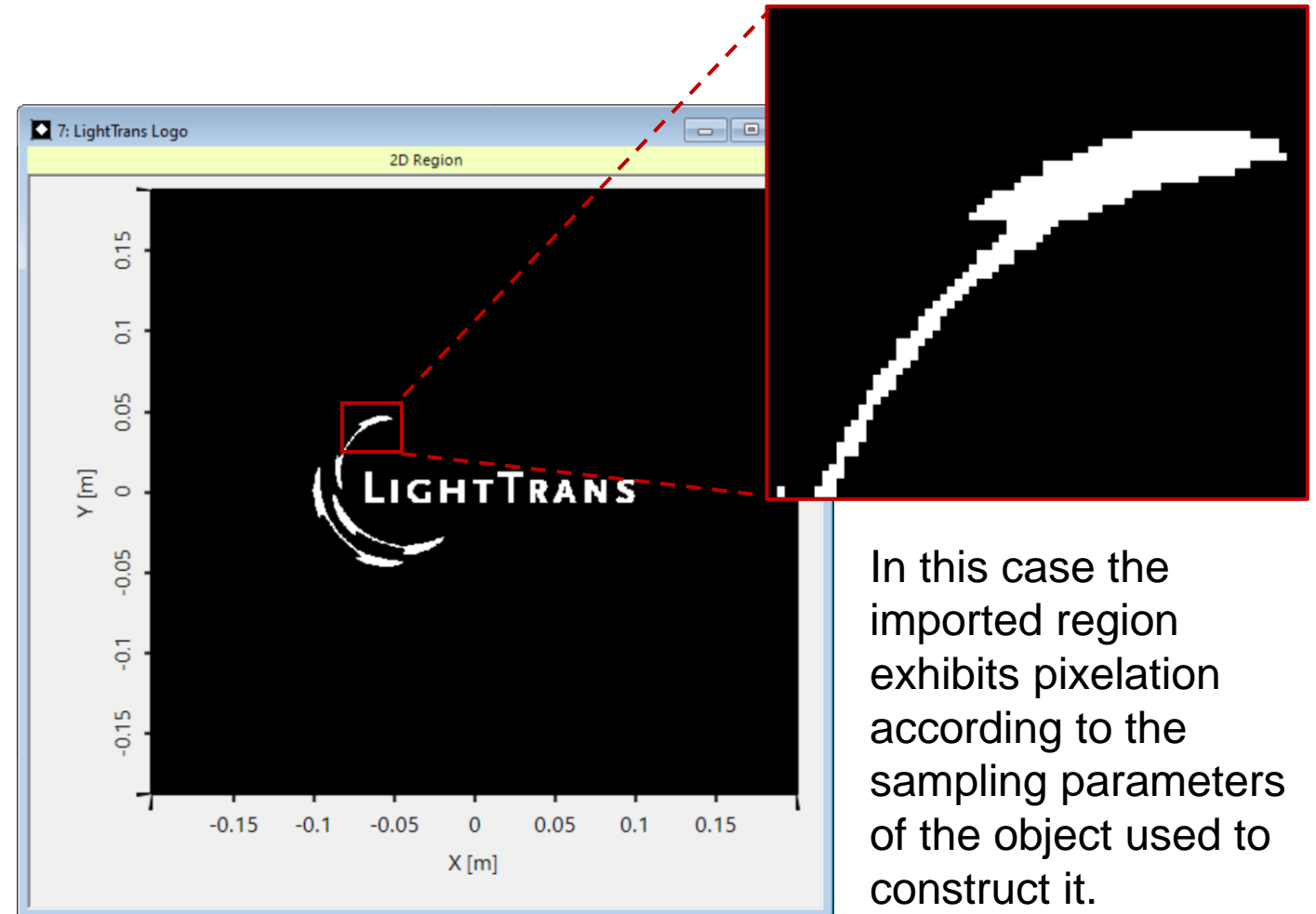
Example regions generated by polygon vertices. From top left, counter-clockwise a hexagon, triangle and trapezoid/irregular quadrilateral.



Sampled Region

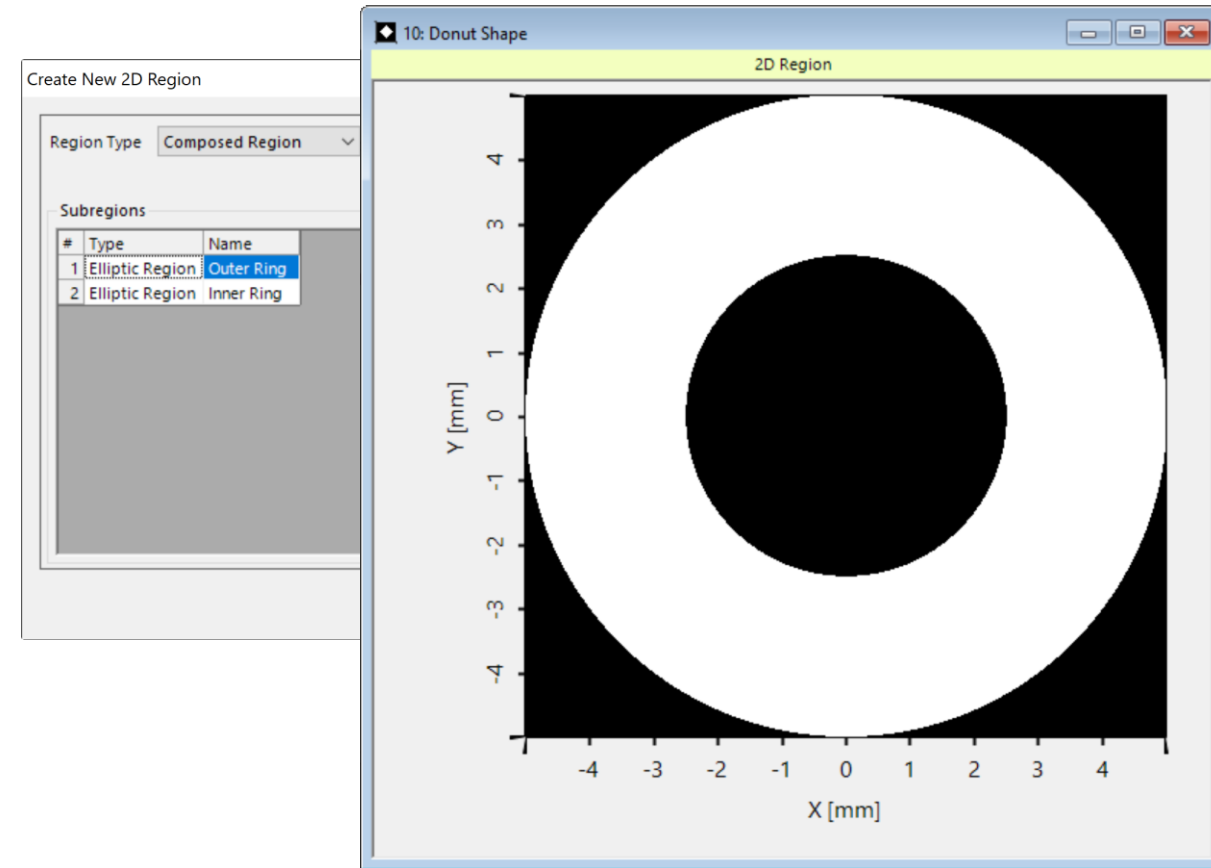
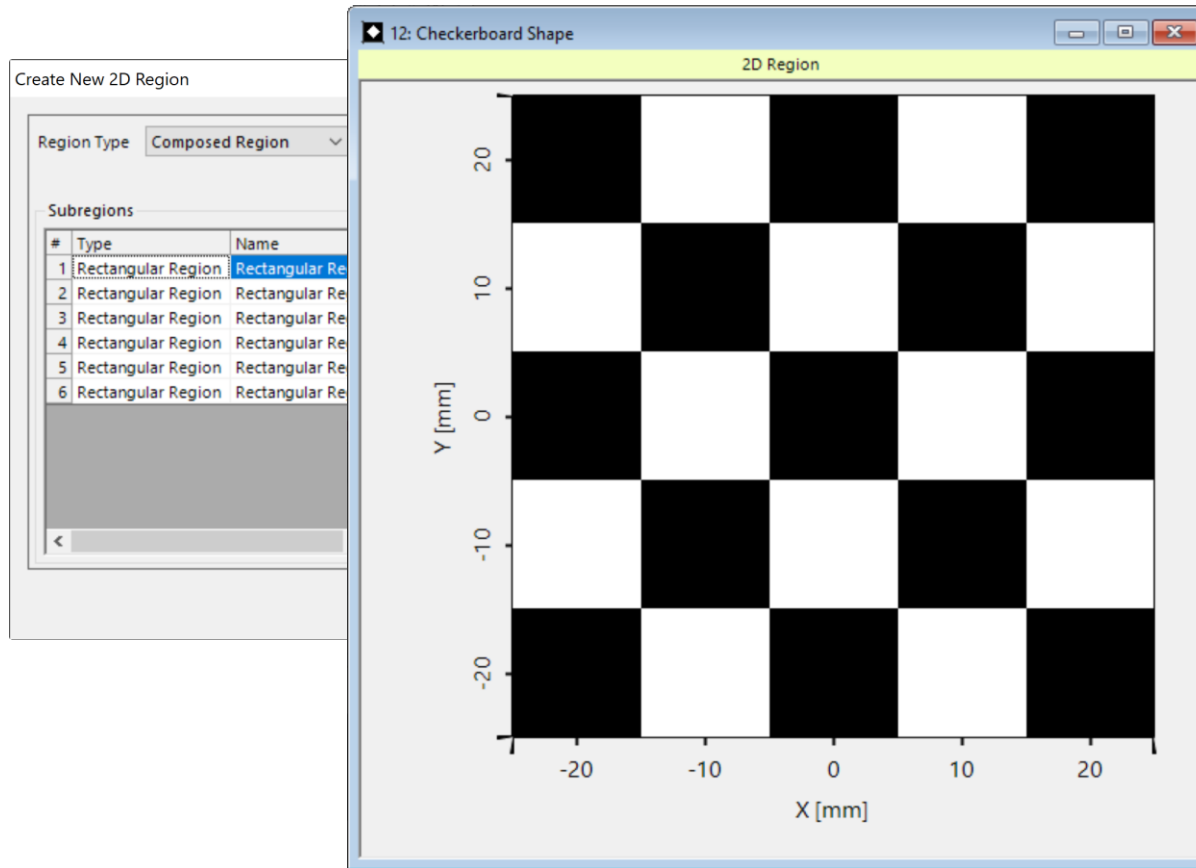


Real-valued data arrays containing a single data set can be selected from among the open documents or otherwise imported to construct specific regions. Bitmaps can also be used after conversion into data arrays. Please note that region definition uses a binary criterion (a given point is either inside or outside the region) so, for non-binary data, values equal to zero are assumed to be outside the region, all others, inside.



In this case the imported region exhibits pixelation according to the sampling parameters of the object used to construct it.

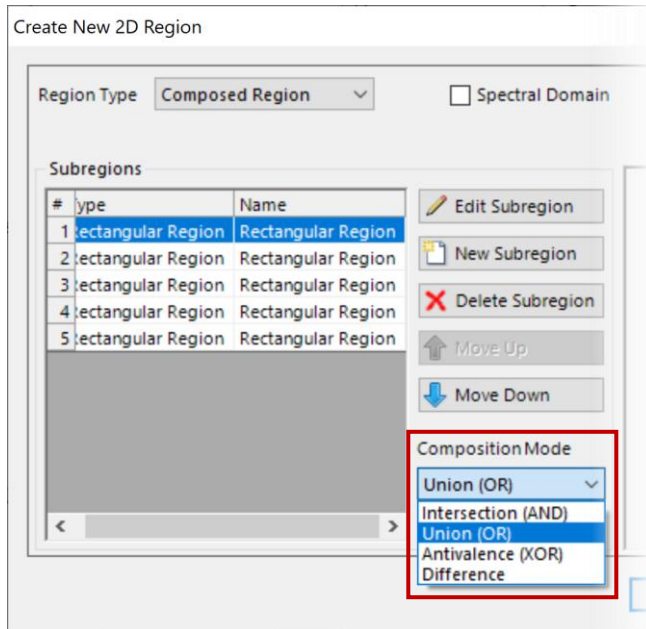
Composed Regions



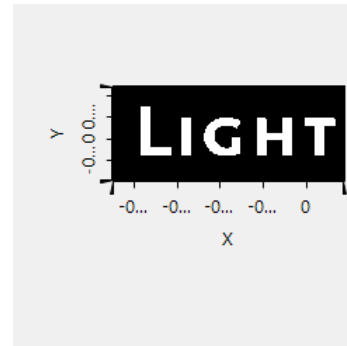
More complex shapes like a donut-like or checkerboard region can be generated using the *Compound Region* type, which combines multiple individual regions according using logical operators.

Regions Composed Using Different Logical Operators

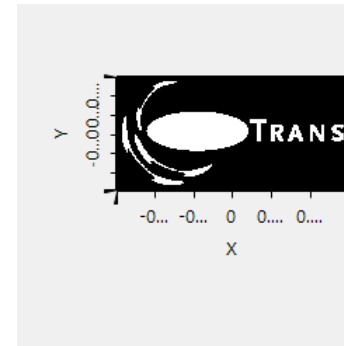
We demonstrate the effect of different operators on the combination of an (analytically defined) ellipse and a sampled region representing the LightTrans logo:



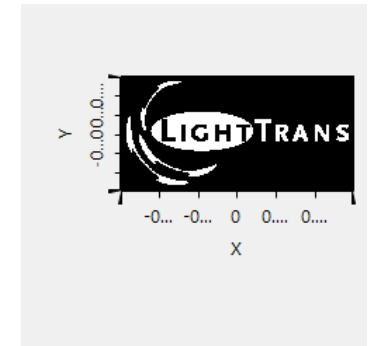
Intersection (AND)



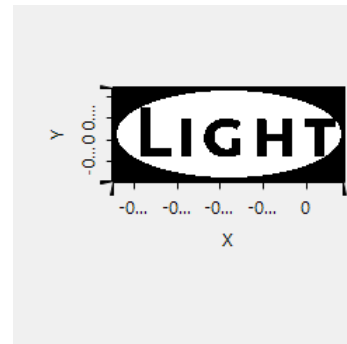
Union (OR)



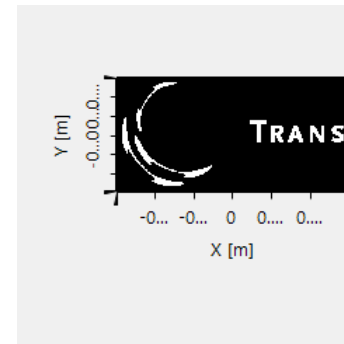
Antivalence (XOR)



Difference A-B



Difference B-A

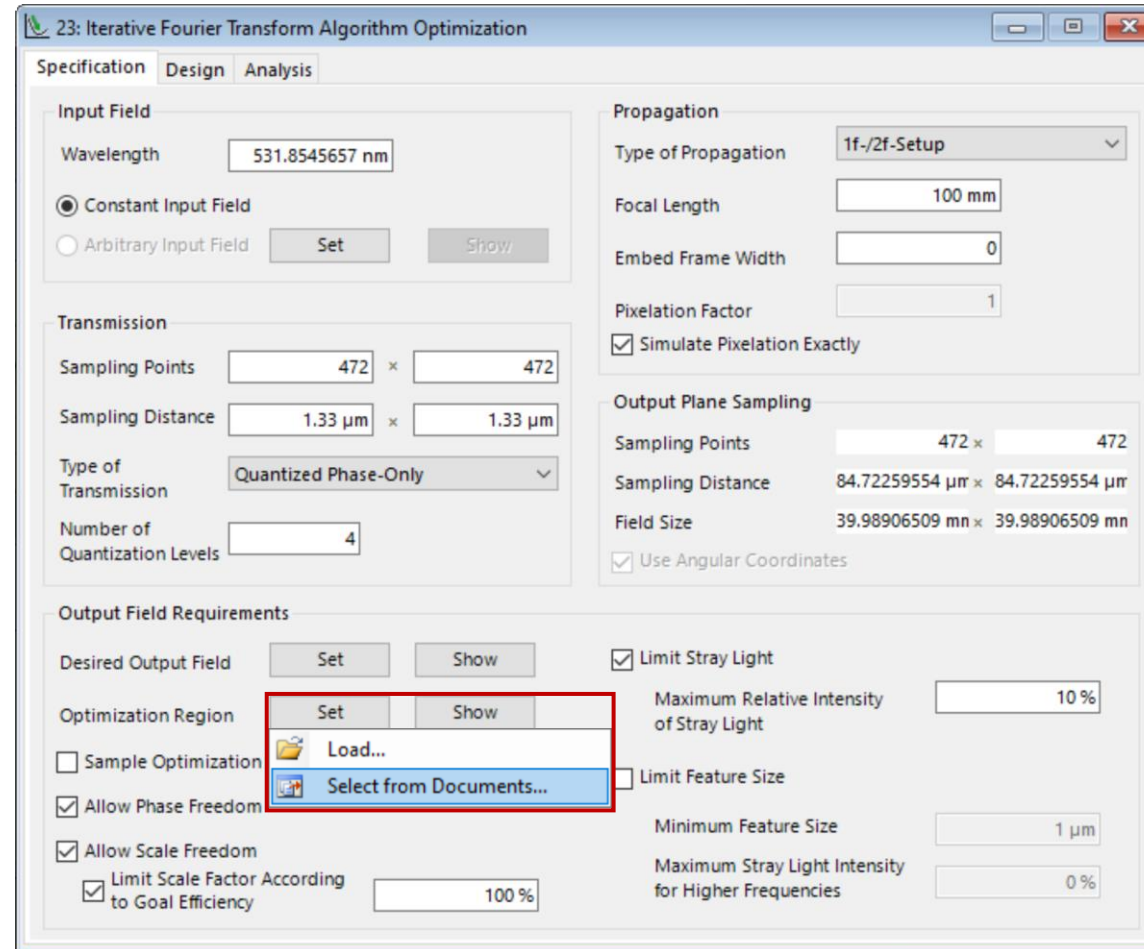


The result of the *Difference* mode depends on the order of the subregions, which can be adjusted using *Move Up* and *Move Down*

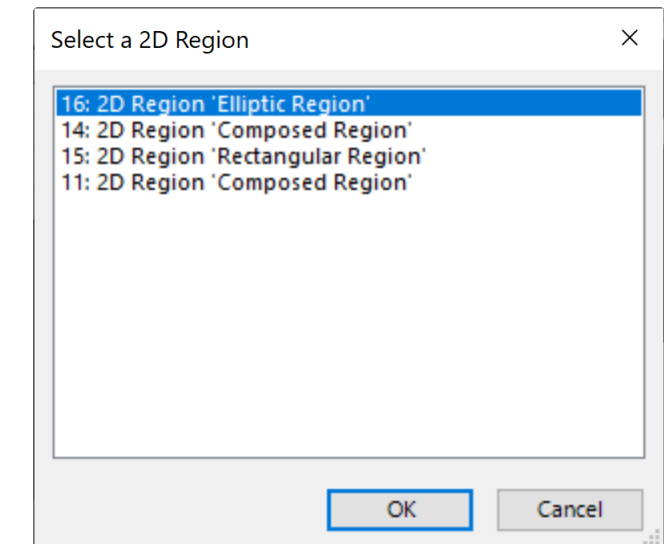


Used as Optimization Region

Regions can be used in any *Iterative Fourier Transform Algorithm (IFTA) Optimization* to define the *Optimization Region*.

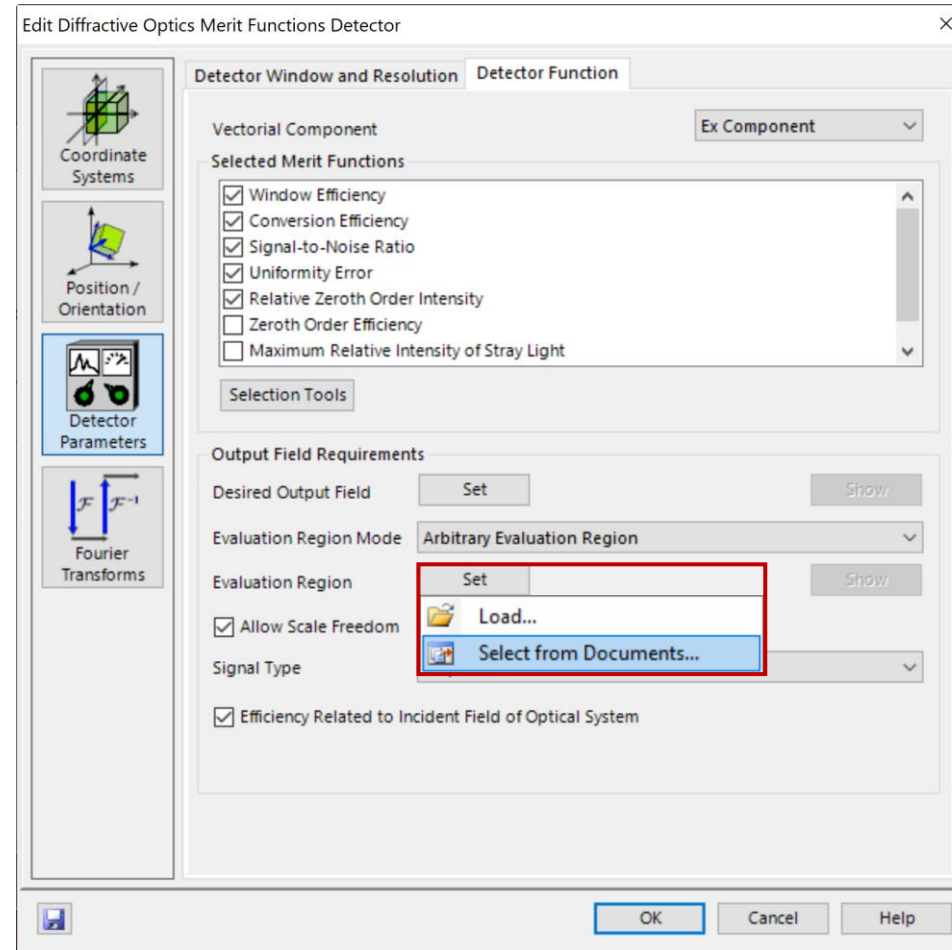


Open region documents can be selected as the *Optimization Region* for the design.

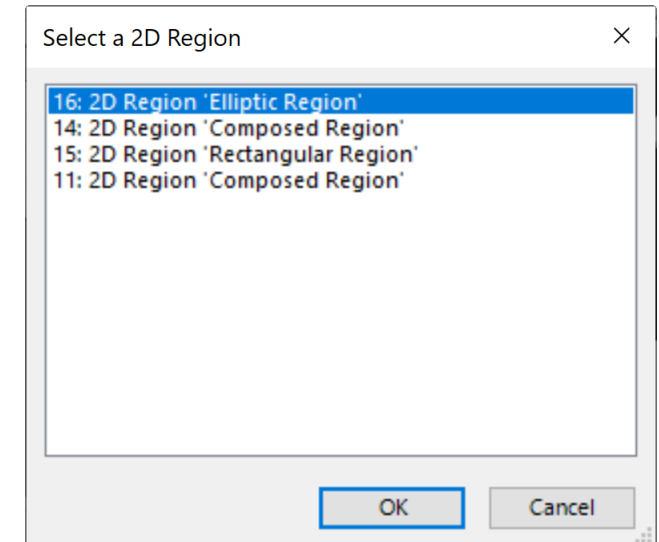


Used as Evaluation Region

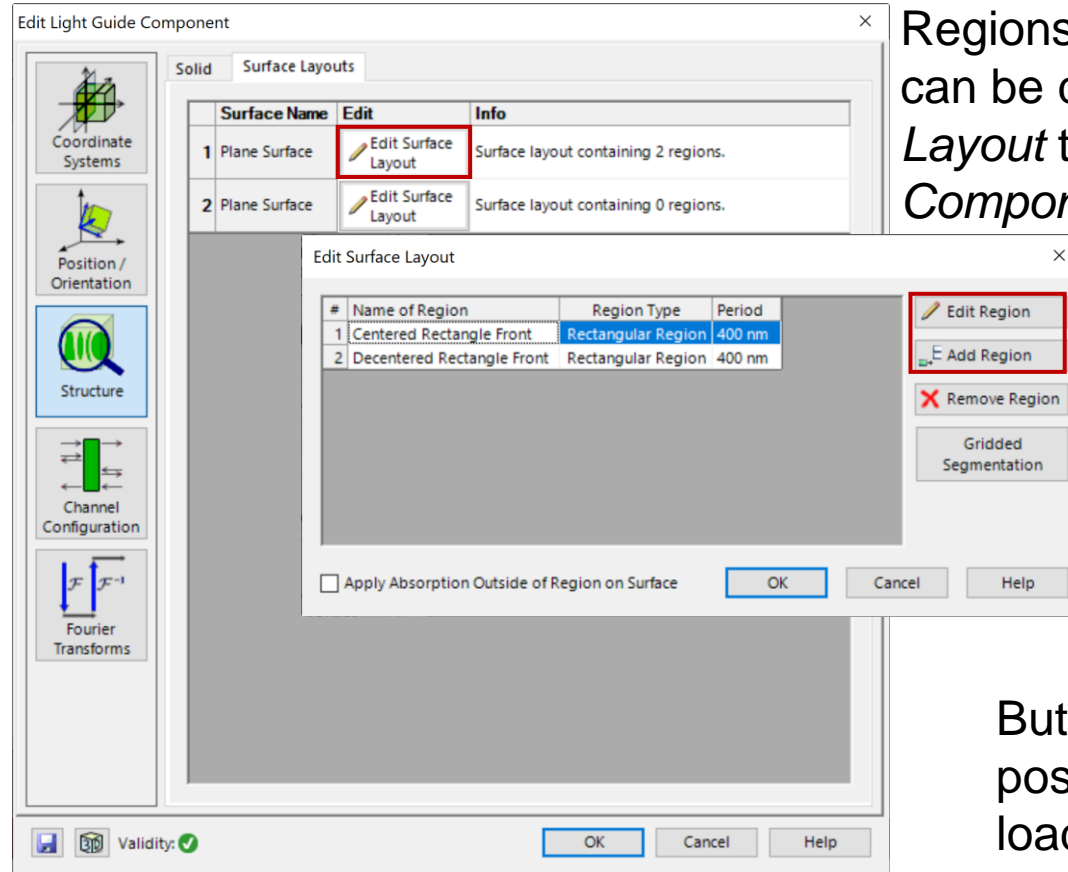
The *Diffraction Optics Merit Functions Detector* can also use a custom region as its *Evaluation Region* used for the calculation of the merit functions.



Open region documents can be selected as the *Evaluation Region* for the design.

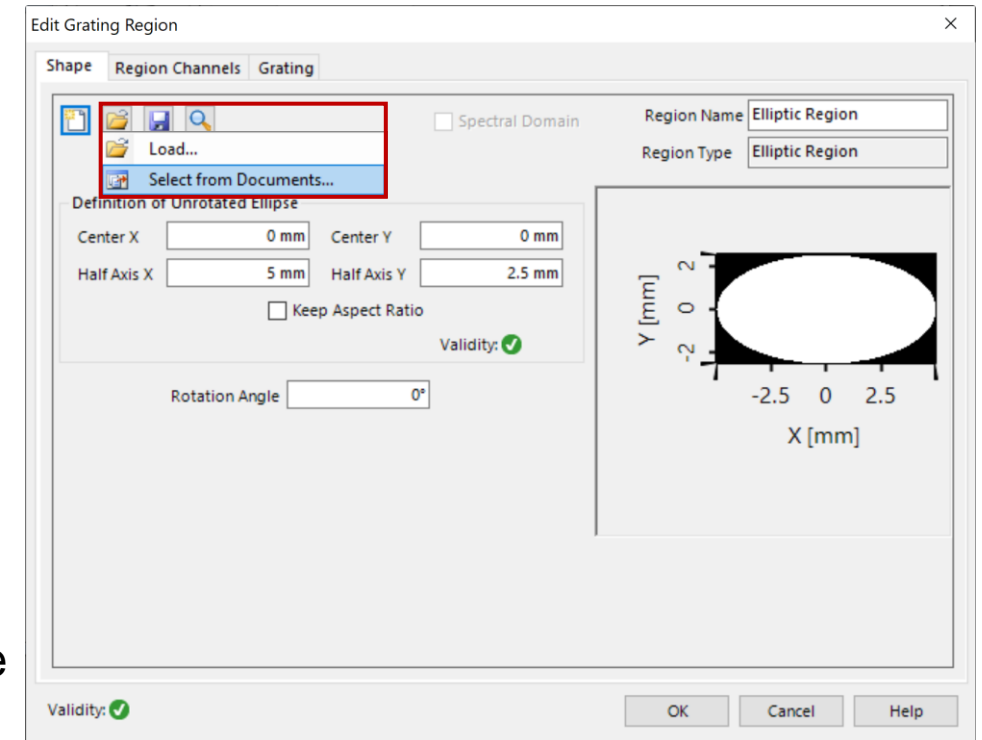


Used in Light Guide Component

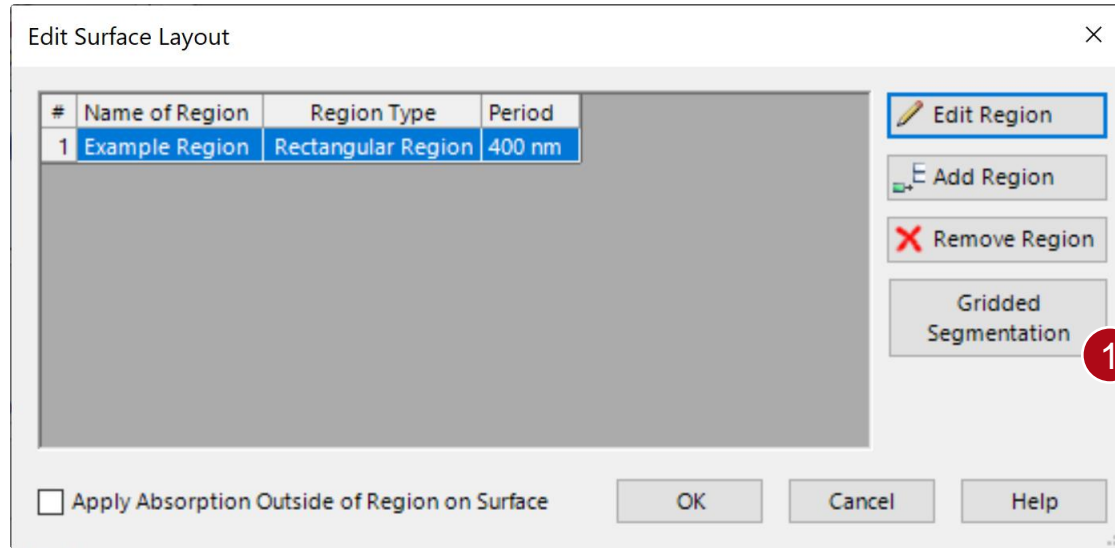


Regions specifically for light guides can be defined inside the *Surface Layout* tab of the *Light Guide Component*.

But it is also possible to load regions previously defined in the main menu.

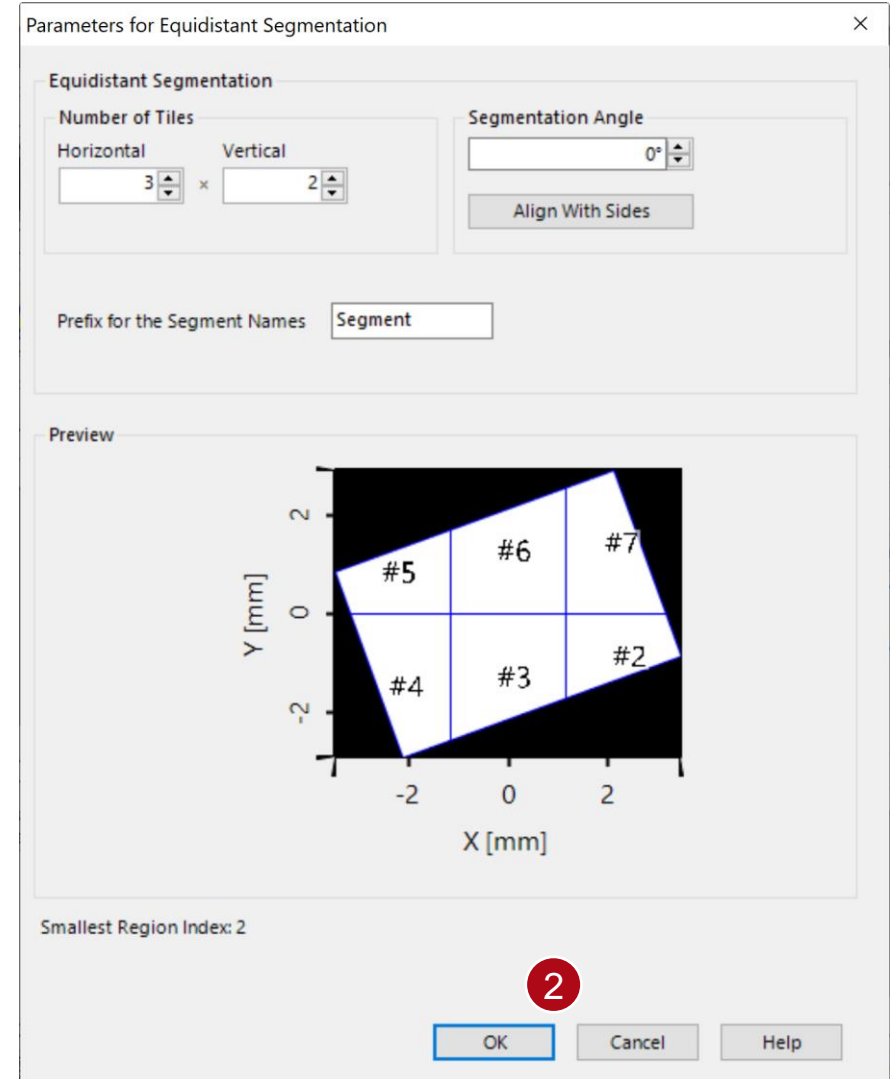


Segmented Gridding

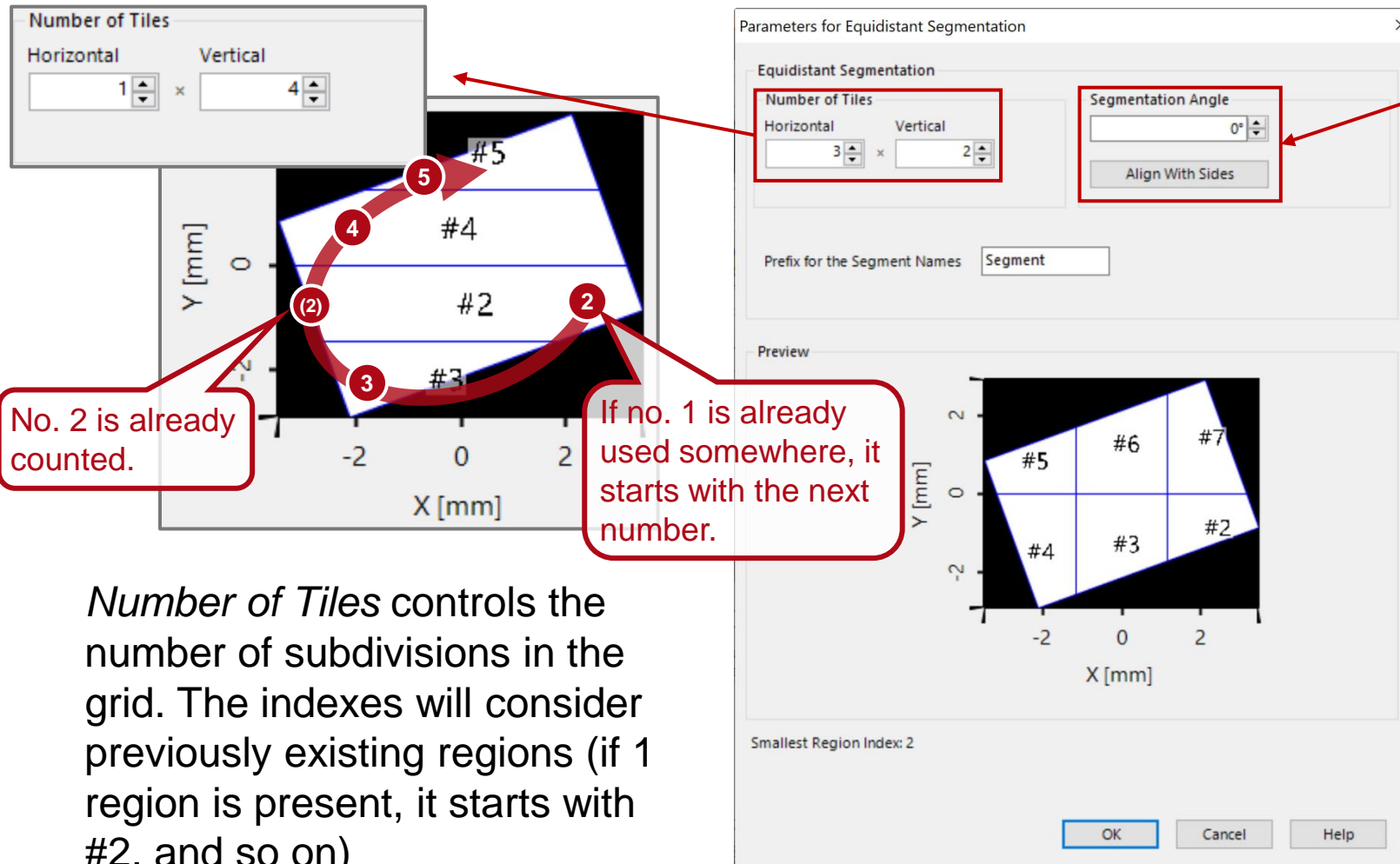


It is possible to break up a rectangular or polygonal grating region using an equidistant grid so that the grating parameters of each individual region can be modified independently from the others. **This can only be done for regions in the *Light Guide Component*.**

#	Name of Region	Region Type	Period
3	Segment #3	Simple Polygon Region	400 nm
4	Segment #4	Simple Polygon Region	400 nm
5	Segment #5	Simple Polygon Region	400 nm
6	Segment #6	Simple Polygon Region	400 nm
7	Segment #7	Simple Polygon Region	400 nm
8	Segment #8	Simple Polygon Region	400 nm



Gridded Segmentation – Options



The image shows a software interface for gridded segmentation. On the left, a 'Number of Tiles' control has 'Horizontal' set to 1 and 'Vertical' set to 4. Below it, a grid visualization shows a tilted rectangle divided into five regions labeled #2, #3, #4, #5, and #6. Red arrows and numbers indicate the counting sequence: starting at #2, then #3, #4, #5, and finally #6. Two red callout boxes provide context: 'No. 2 is already counted.' and 'If no. 1 is already used somewhere, it starts with the next number.' On the right, the 'Parameters for Equidistant Segmentation' dialog box is shown. It has a 'Number of Tiles' section with 'Horizontal' set to 3 and 'Vertical' set to 2. A 'Segmentation Angle' section shows '0°' and an 'Align With Sides' button. Below these is a 'Preview' window showing a 3x2 grid of regions labeled #2 through #7. At the bottom, it says 'Smallest Region Index: 2' and has 'OK', 'Cancel', and 'Help' buttons.

Number of Tiles
Horizontal: 1 × Vertical: 4

No. 2 is already counted.

If no. 1 is already used somewhere, it starts with the next number.

Number of Tiles
Horizontal: 3 × Vertical: 2

Segmentation Angle: 0°
Align With Sides

Prefix for the Segment Names: Segment

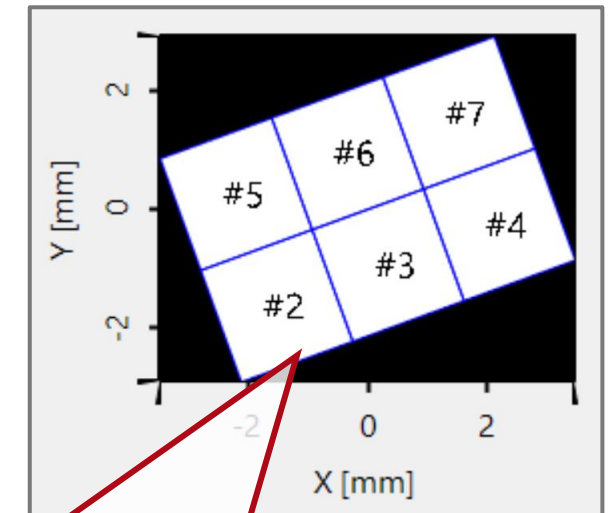
Preview

Smallest Region Index: 2

OK Cancel Help

Number of Tiles controls the number of subdivisions in the grid. The indexes will consider previously existing regions (if 1 region is present, it starts with #2, and so on)

The angle for the segmentation is also customizable. For rectangular gratings it is possible to automatically detect and align with the rotation of the rectangle.



In case of an axially parallel segmentation of rectangles the counting order goes differently (along x- then y-coordinates).

Document Information

title	Flexible Region Definition
document code	Misc.0091
document version	1.1
software edition	<ul style="list-style-type: none">• VirtualLab Fusion Basic• VirtualLab Fusion Basic with Diffractive Toolbox Silver (for IFTA)• VirtualLab Fusion Advanced (for Light Guide component)
software version	2021.1 (Build 1.180)
category	Feature Use Case
further reading	- <u>Specification of Diffraction Orders and Efficiencies for Grating Regions</u>