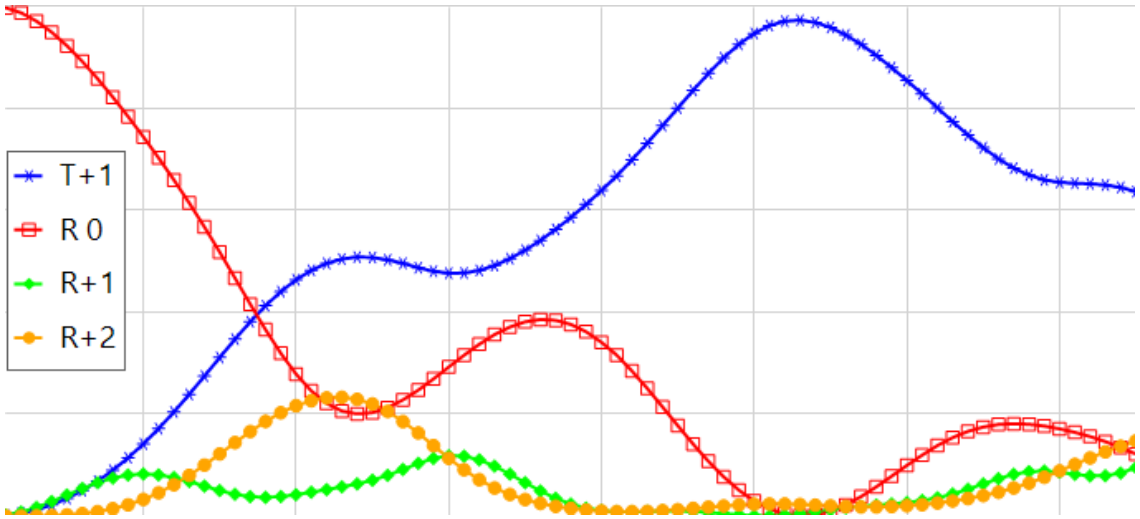
Analysis of Slanted Gratings for Lightguide Coupling

Abstract



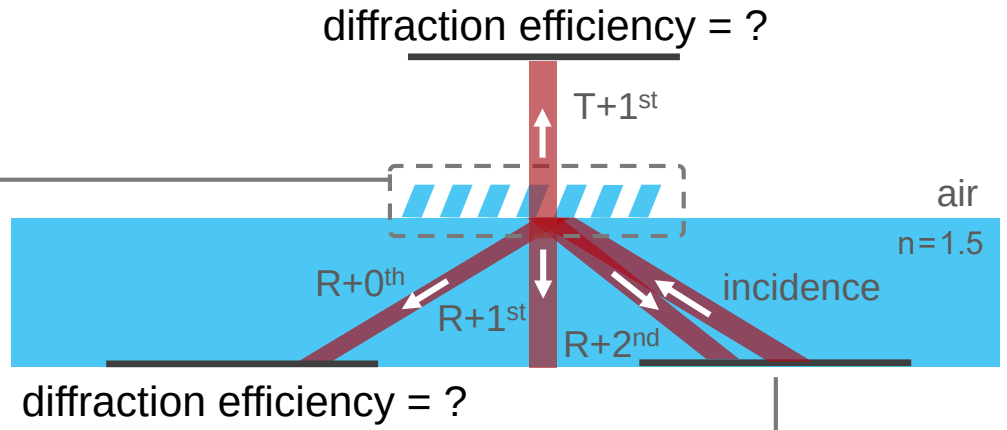
Slanted gratings are commonly used for coupling light into optical lightguides due to their high efficiency in a certain diffraction order. Nowadays, they are often applied in the augmented and mixed reality applications. It will be shown how VirtualLab Fusion can be used to analyze certain slanted grating geometries from literature, with specific parameters like slant angle, fill factor, and modulation depth. In addition, the effect of different incidence angles on the diffraction efficiency is investigated.

Modeling Task

How to calculate the diffraction efficiencies of the coupling grating, with varying grating parameters?

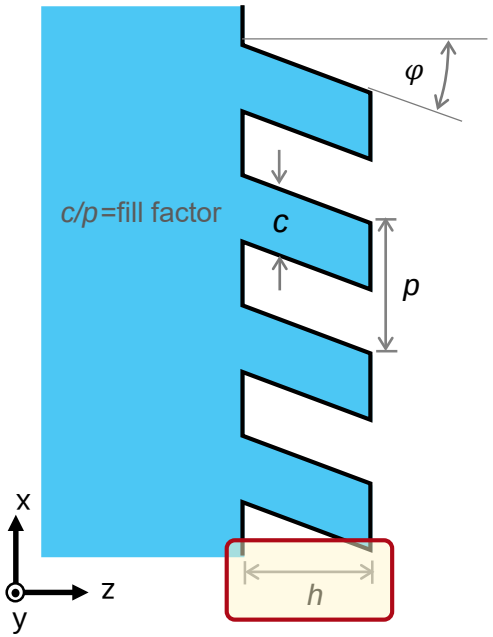
slanted grating
- period: 596.92 nm
- relative depth
- fill factor
- slant angle

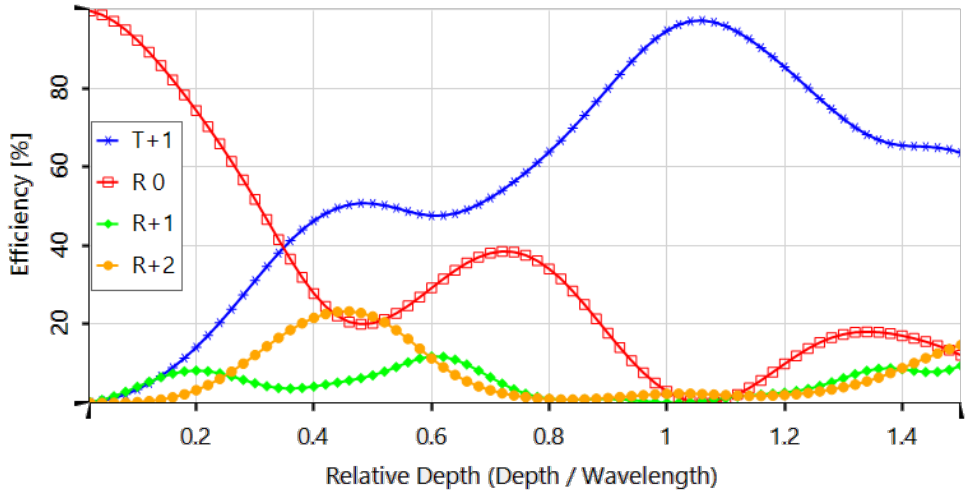
to be varied



input plane wave
- wavelength: 633 nm
- angle of incidence: -45°
- TE polarized

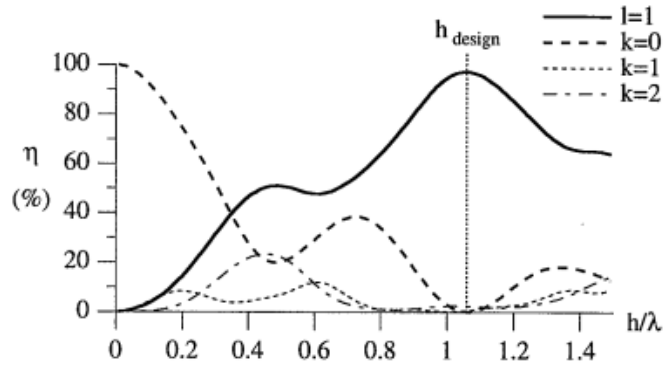
Diffraction Efficiency vs. Relative Depth





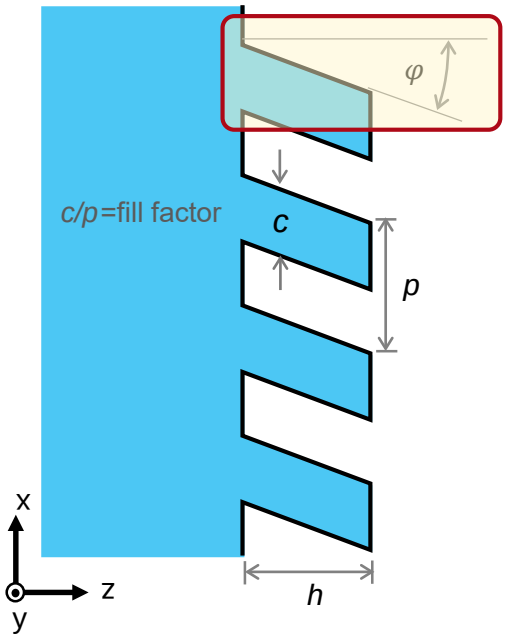
simulation by Fourier modal method (FMM), also known as RCWA, in VirtualLab Fusion

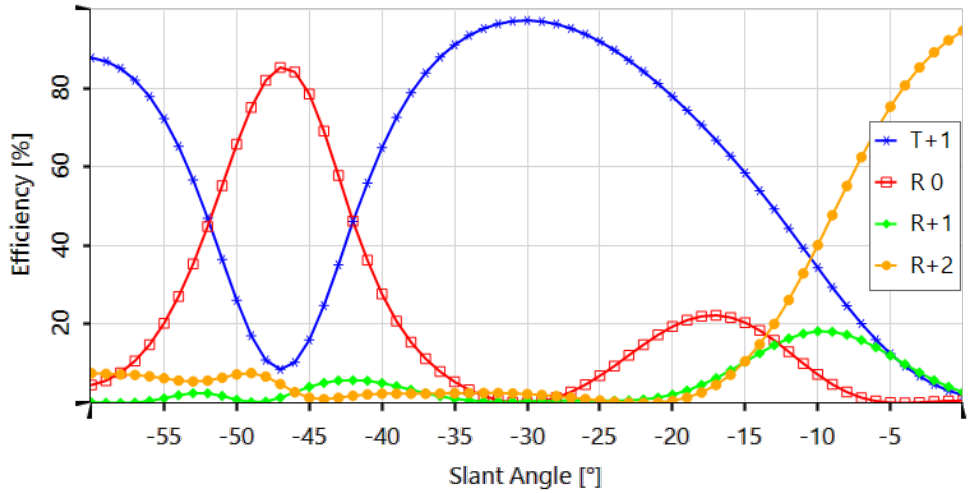
Grating Parameter	Value & Unit
relative depth	**to be varied**
slant angle φ	-30°
fill factor c/p	50%



Reference: J. Michael Miller, Nicole de Beaucoudrey, Pierre Chavel, Jari Turunen, and Edmond Cambril, "Design and fabrication of binary slanted surface-relief gratings for a planar optical interconnection," Appl. Opt. 36, 5717-5727 (1997)

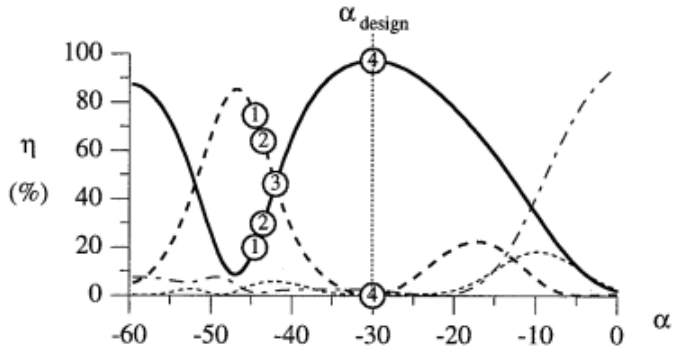
Diffraction Efficiency vs. Slant Angle





simulation by Fourier modal method (FMM), also known as RCWA, in VirtualLab Fusion

Grating Parameter	Value & Unit
relative depth	1.058 λ
slant angle φ	**to be varied**
fill factor c/p	50%



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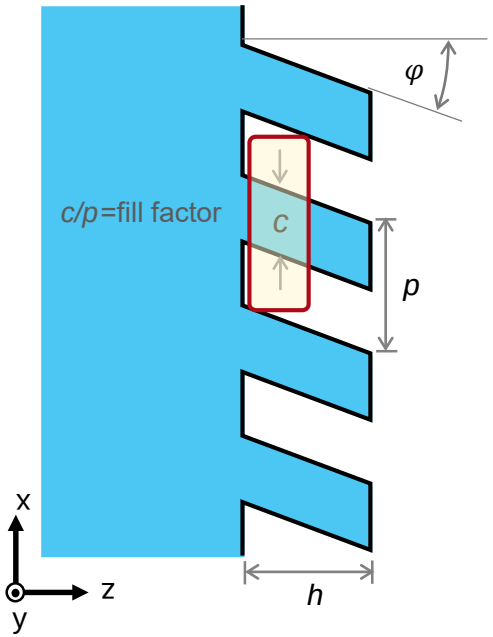
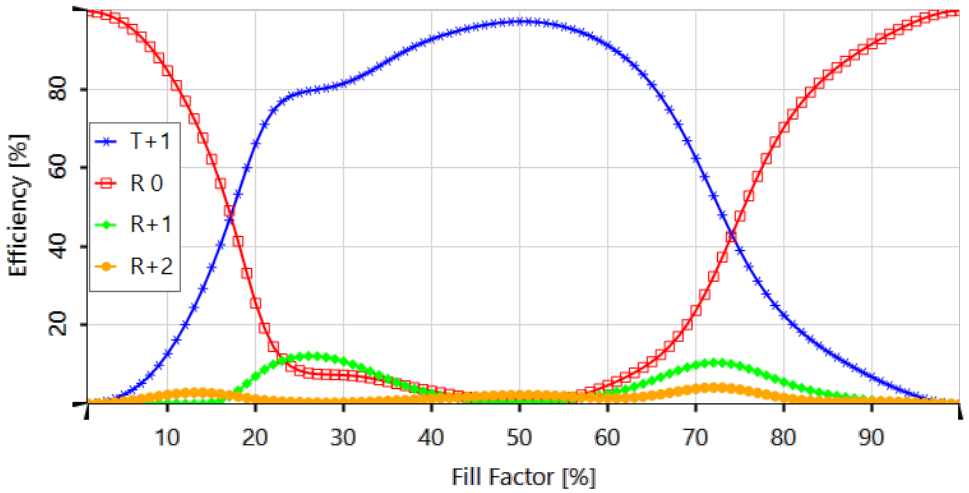
Diffraction Efficiency vs. Fill Factor





simulation by Fourier modal method (FMM), also known as RCWA, in VirtualLab Fusion

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relative depth	1.058 λ
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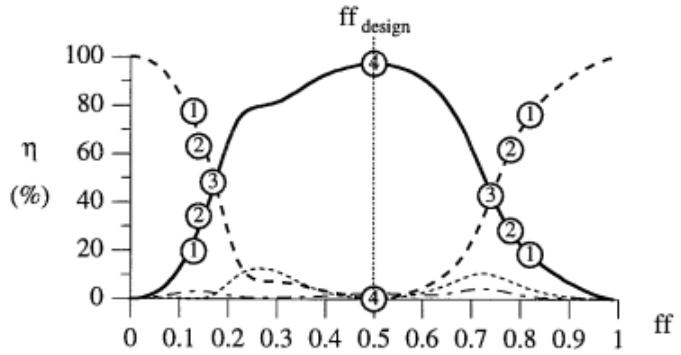

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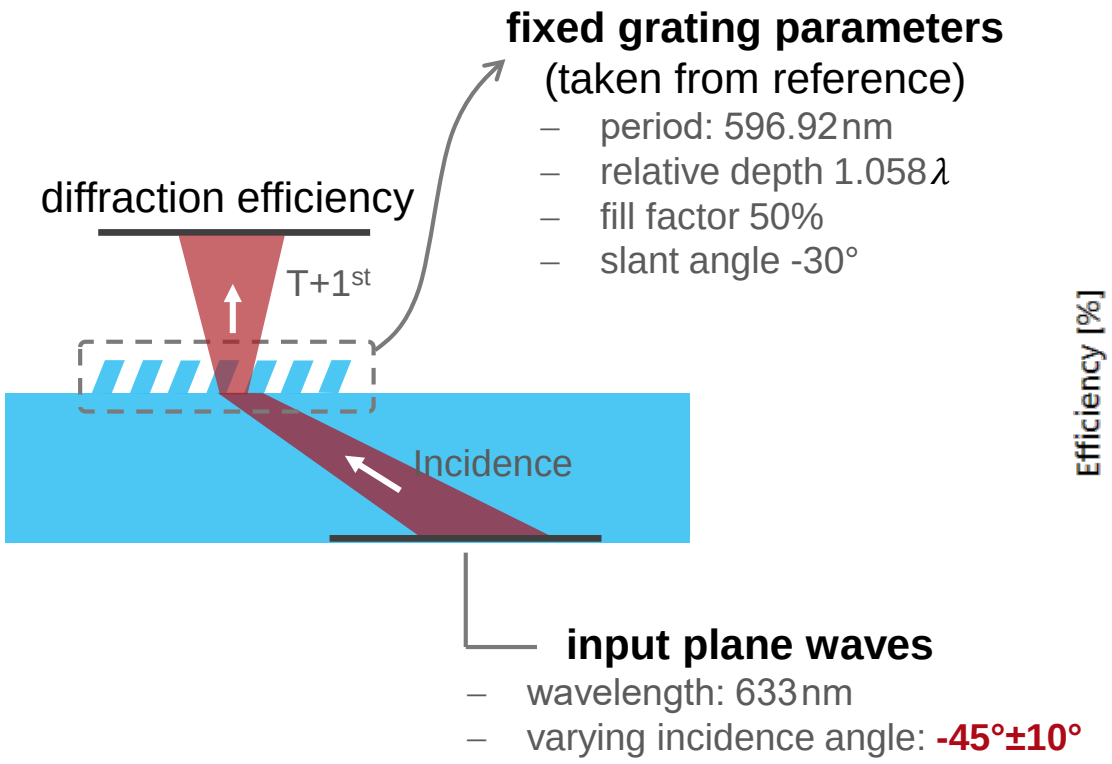
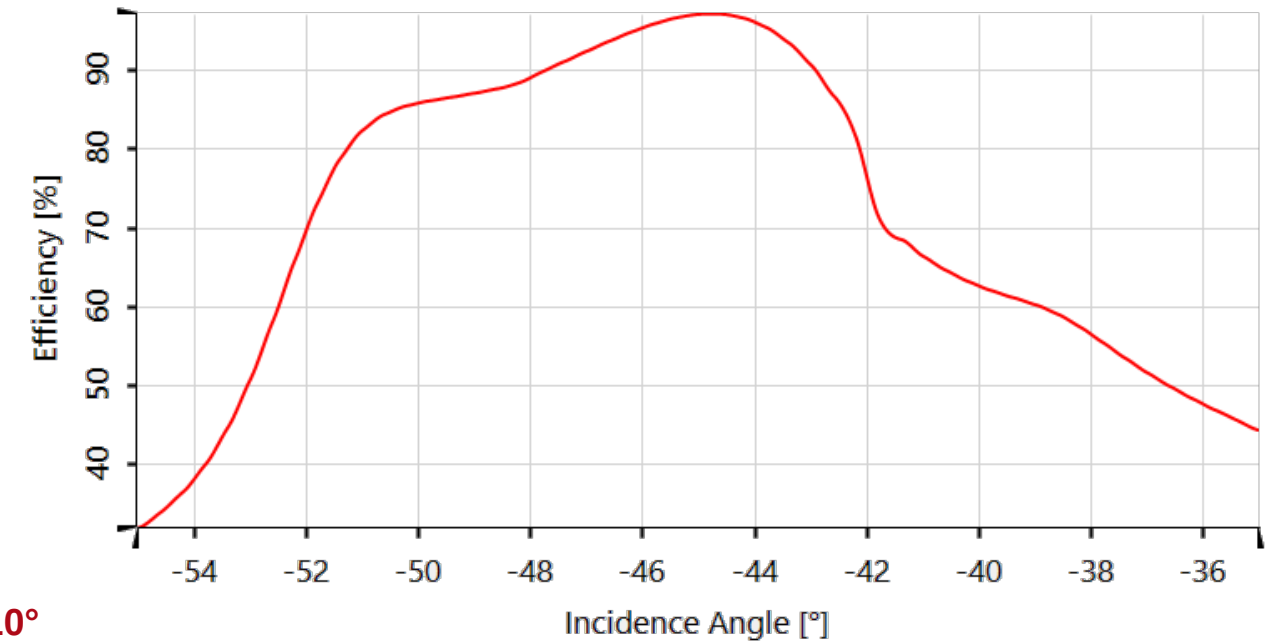
Diffraction Efficiency vs. Varying Incidence Angle

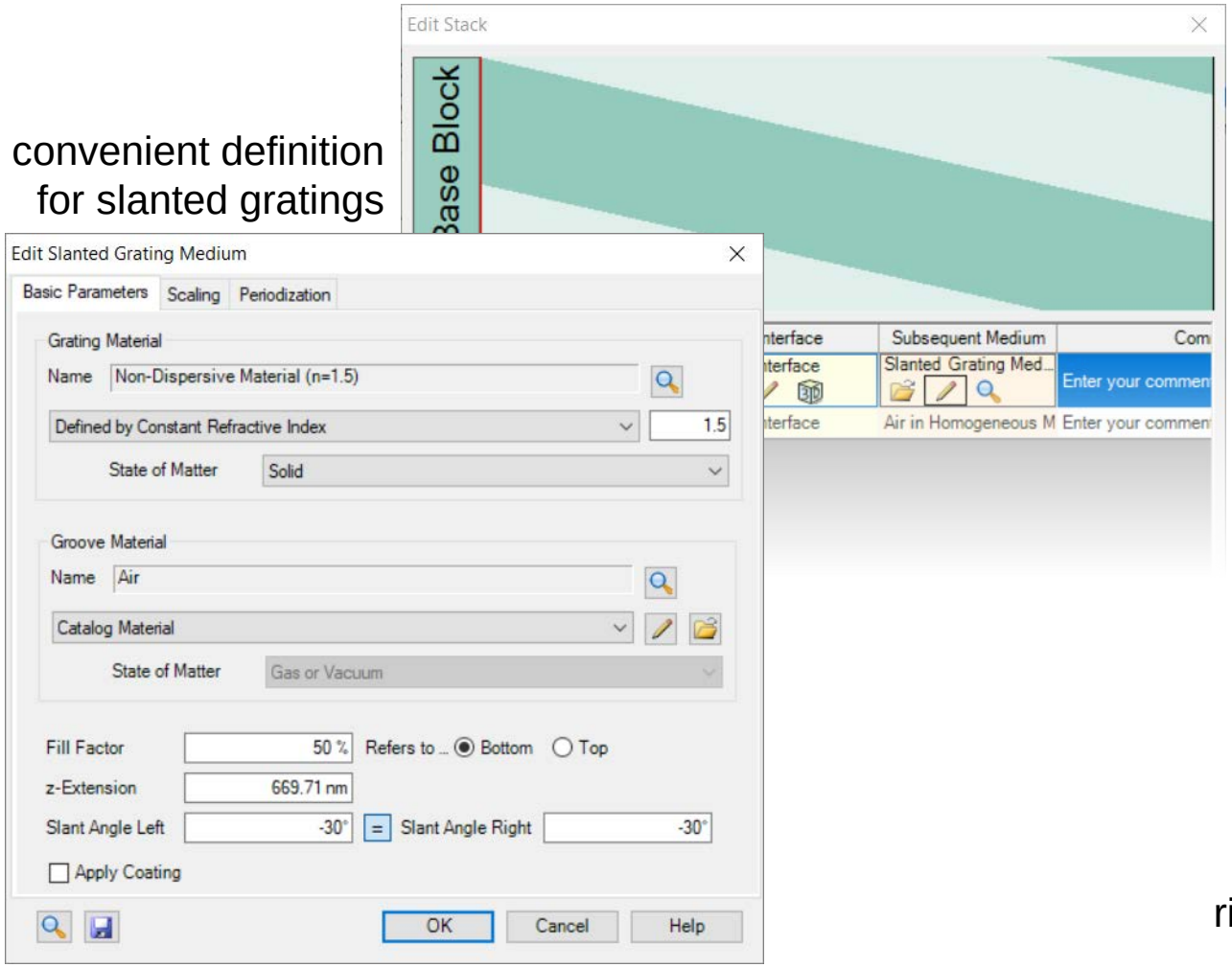


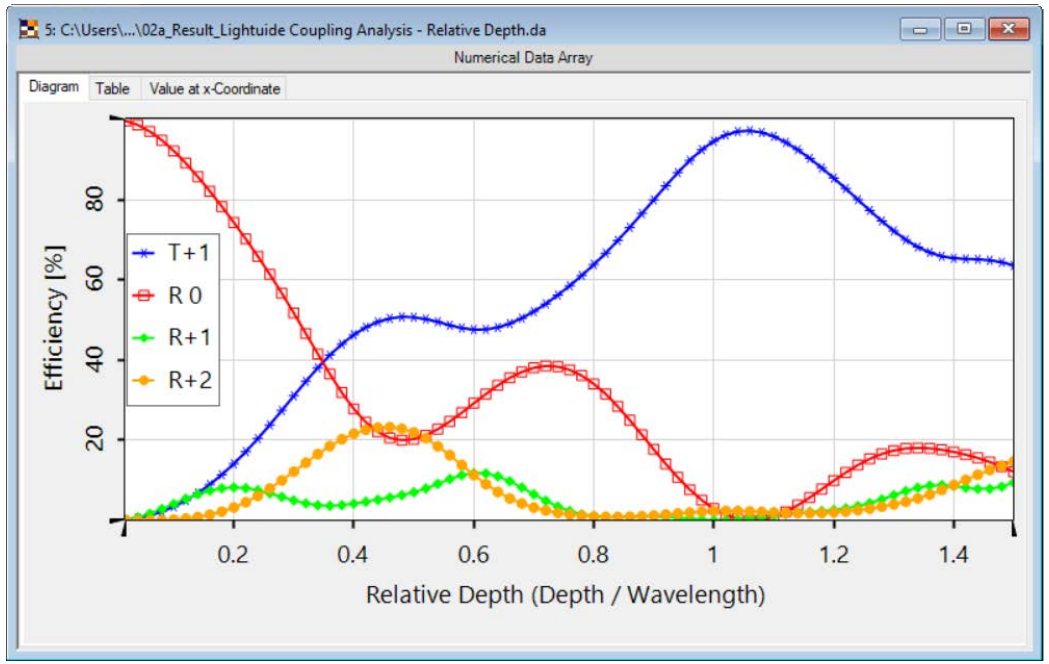


Grating diffraction efficiency is usually sensitive to the angle of incidence.

Peek into VirtualLab Fusion

convenient definition
for slanted gratings

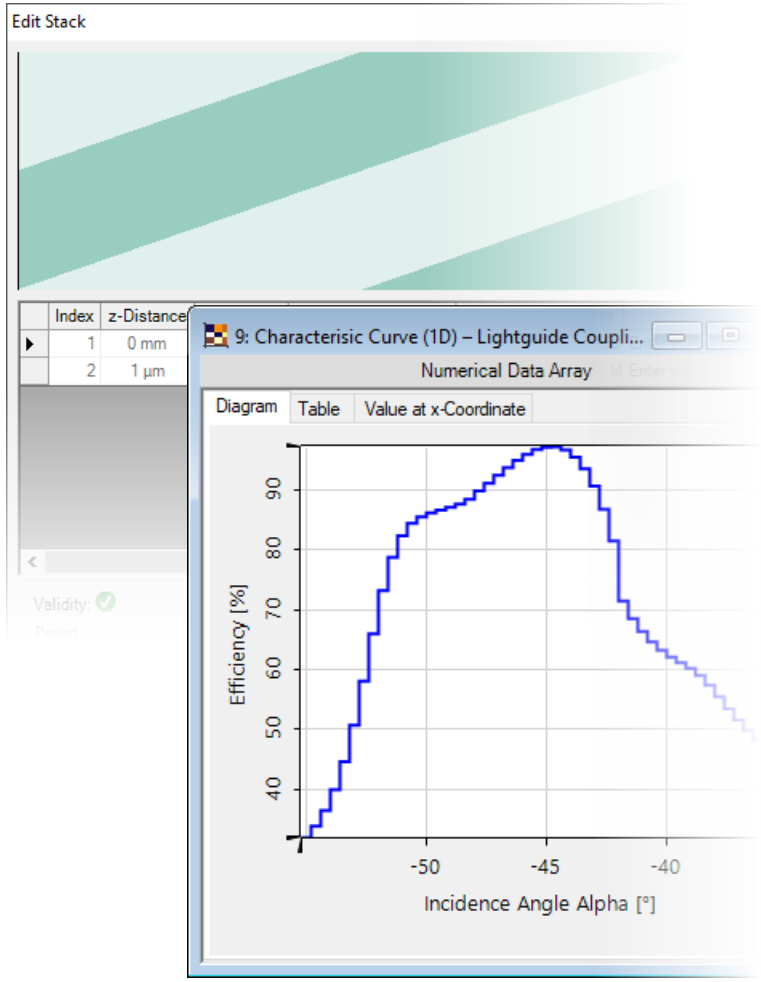




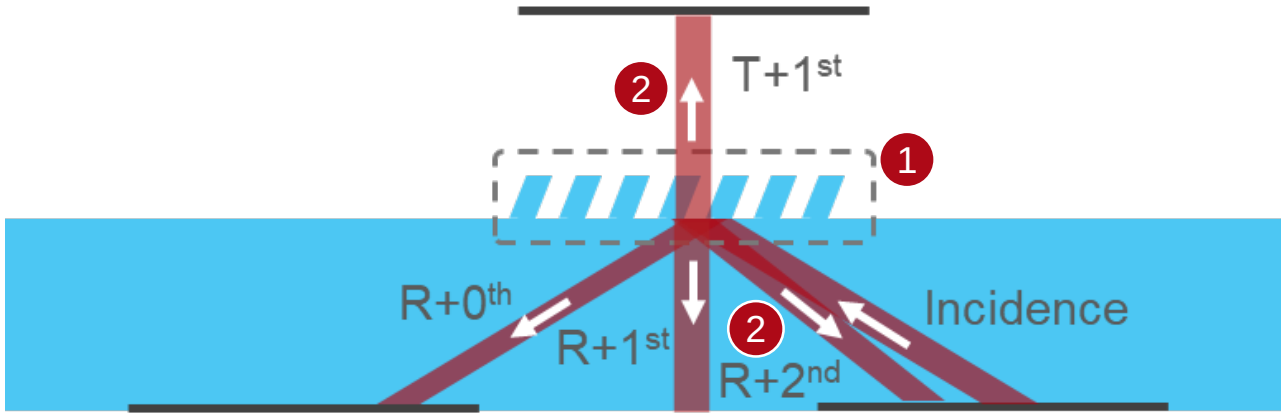
rigorous diffraction efficiency calculation and visualization

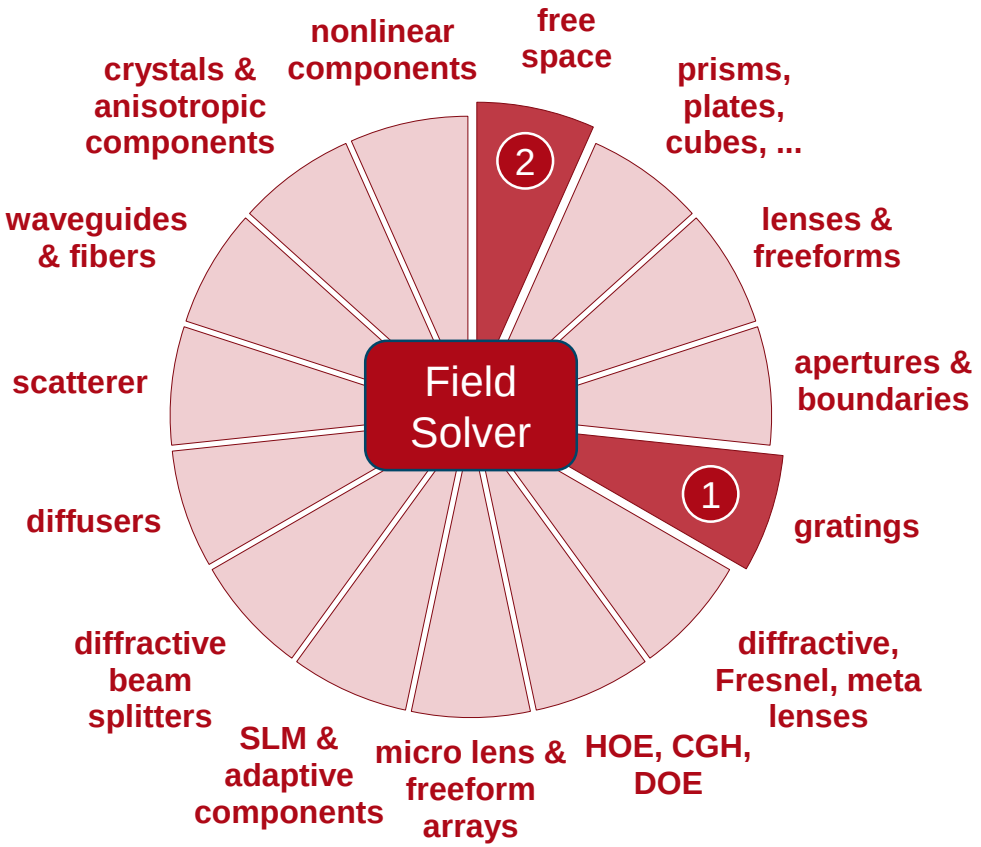
Workflow in VirtualLab Fusion

- Configuration of lightguide coupling grating structure
  - Advanced Configuration of Slanted Grating [Use Case]
  - Configuration of Grating Structures by Using Special Media [Use Case]
  - Configuration of Grating Structures by Using Interfaces [Use Case]
- Analyze coupling grating diffraction efficiency
  - Customized Detector for Lightguide Coupling Grating Evaluation [Use Case]
- Check efficiency by scanning over specific parameter



VirtualLab Fusion Technologies





Document Information

title	Analysis of Slanted Gratings for Lightguide Coupling
document code	LGC.0001
version	1.0
toolbox(es)	Starter Toolbox, Grating Toolbox
VL version used for simulations	7.4.0.49
category	Application Use Case
further reading	- Customized Detector for Lightguide Coupling Grating Evaluation