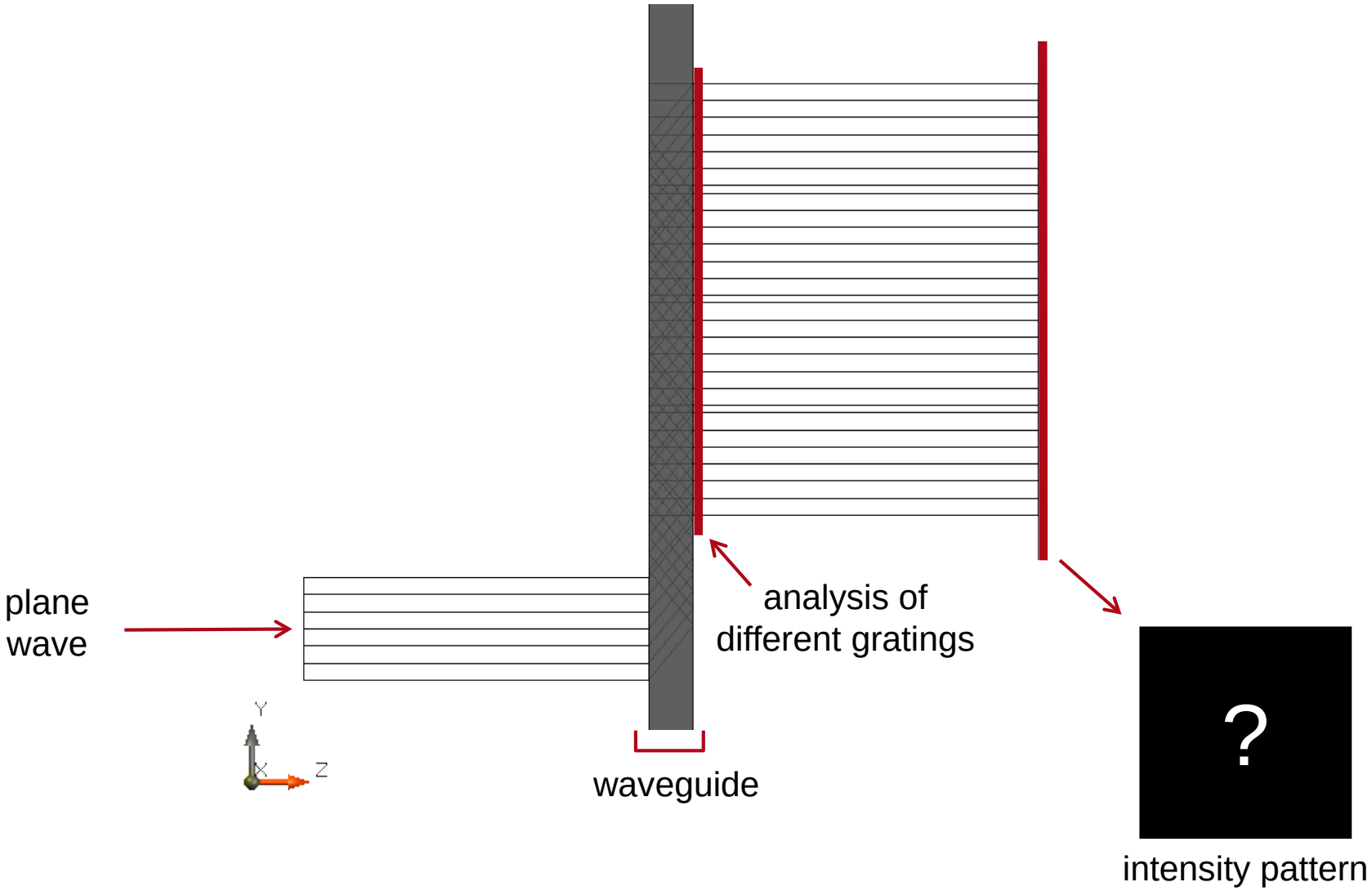
LightTrans

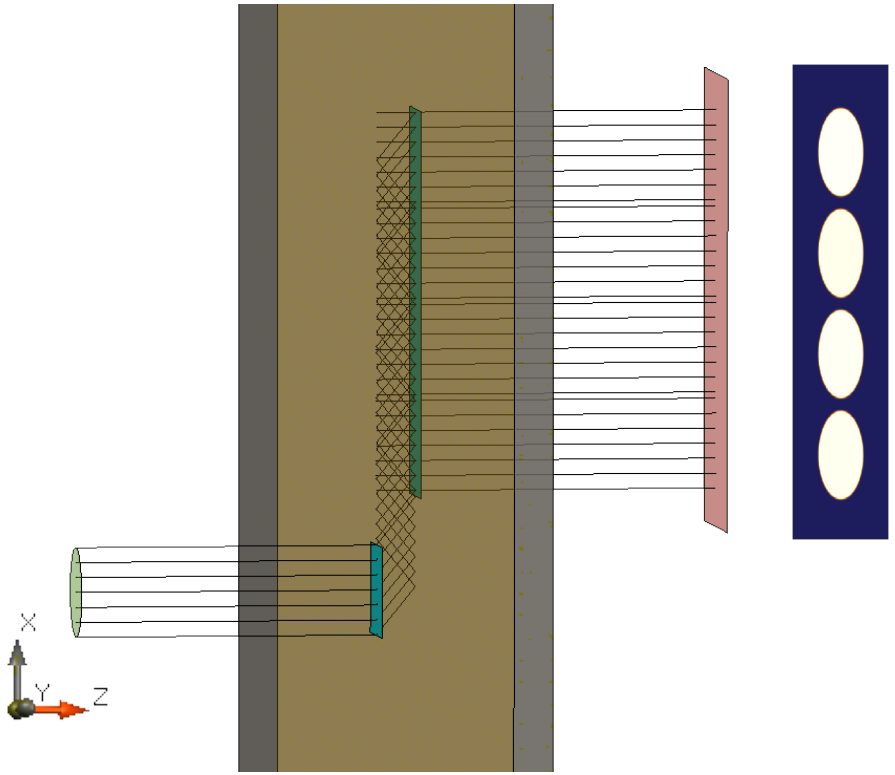
Virtual & Mixed Reality > Near-Eye Displays

Waveguide with Uniform Multiple Output Using Rigorously Analyzed Gratings

Task/System Illustration

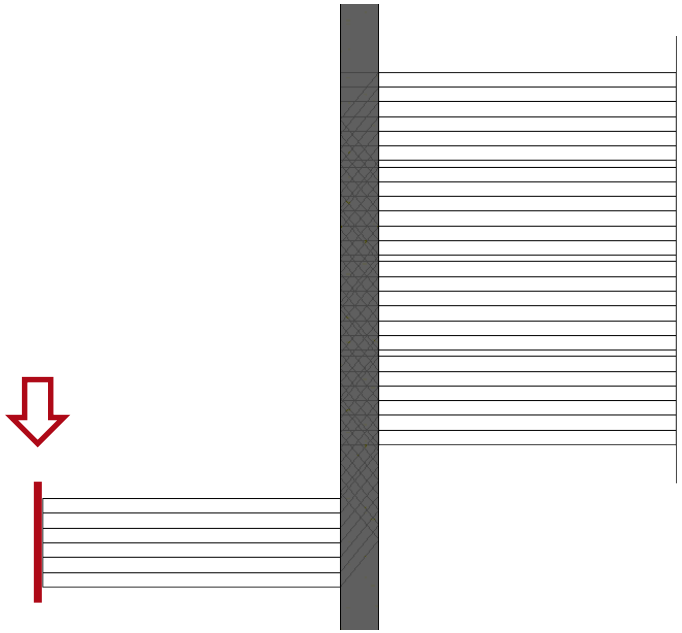


Highlights



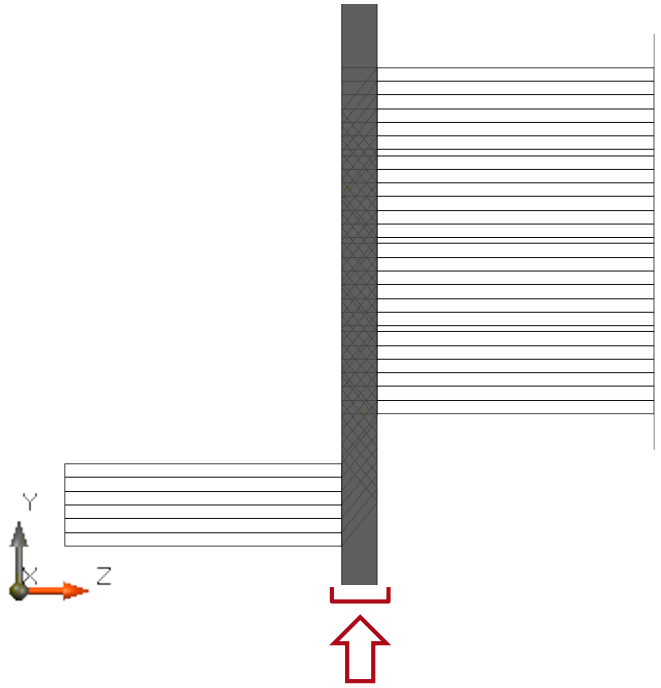
- waveguide simulations including rigorously calculated efficiencies of sub-wavelength grating structures
- specification & optimization of multiple grating regions for tailored output generation

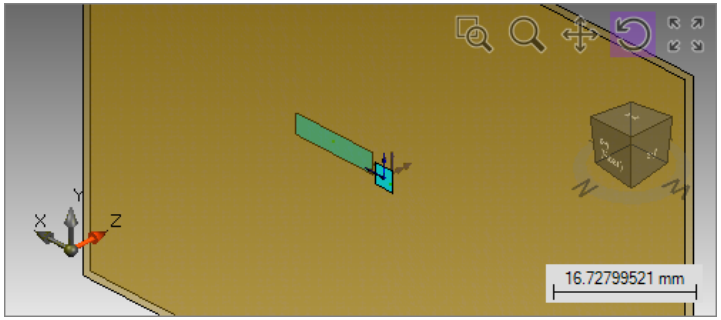
Specification: Light Source



Parameter	Description / Value & Unit
type	plane wave
wavelength	525 nm
polarization	linear in x-direction (0°)
aperture	2.7 mm × 2.7 mm

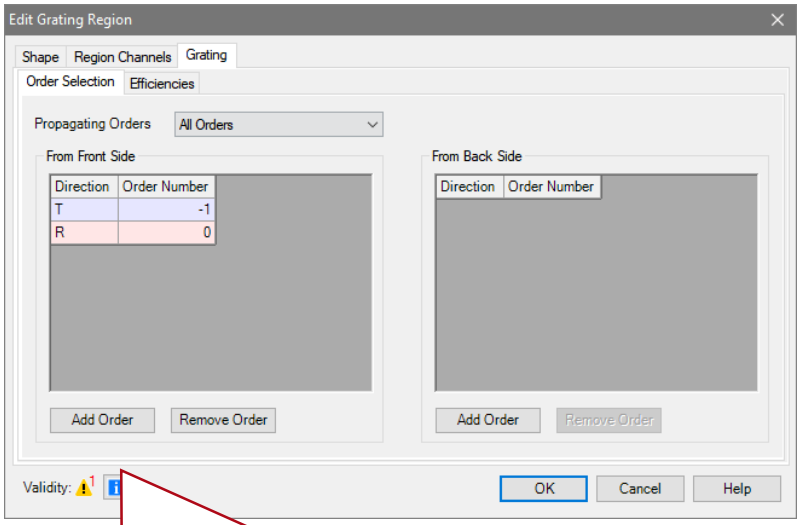
Specification: Waveguide





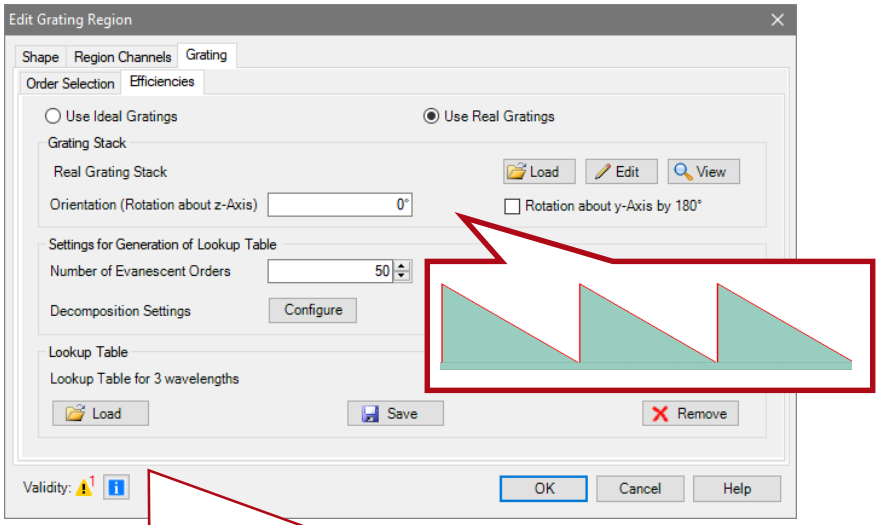
Parameter	Value & Unit
general geometry	parallel planes
thickness	1.3mm
material	n = 1.71
input region size	3mm × 3mm
input region position	0 × 0
output region size	12.8mm × 3mm
output region position	9.5mm × 0mm

Specification: Grating



selection of regarded diffraction orders $(\dots, -2, -1, 0, +1, +2, \dots)$ per

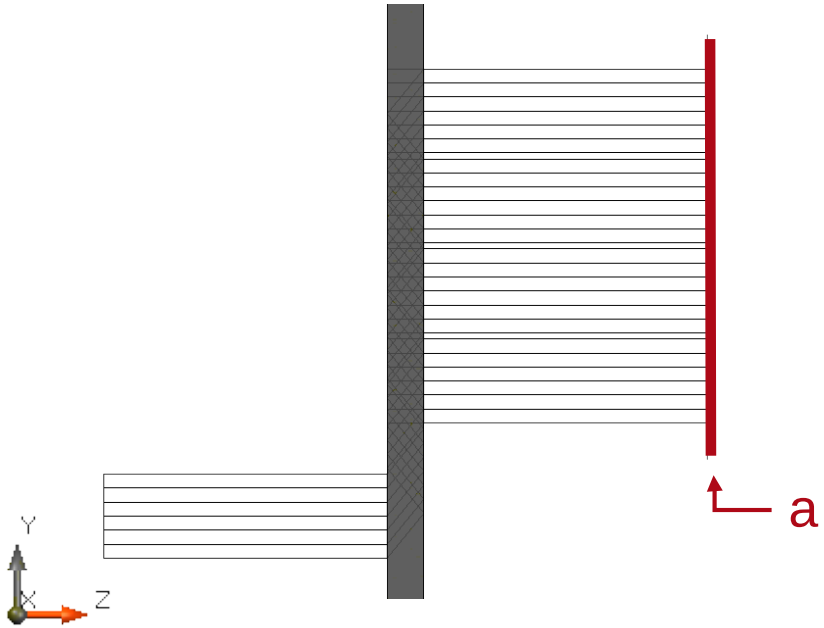
- grating region
- regarded incident direction (from front & back side)
- transmission (T) & reflection (R) channel



- specification of arbitrary grating structures
- rigorous calculation of grating diffraction order efficiencies using Fourier Modal Method (FMM)
- high analysis & simulation speed due to lookup table concept for calculated efficiencies

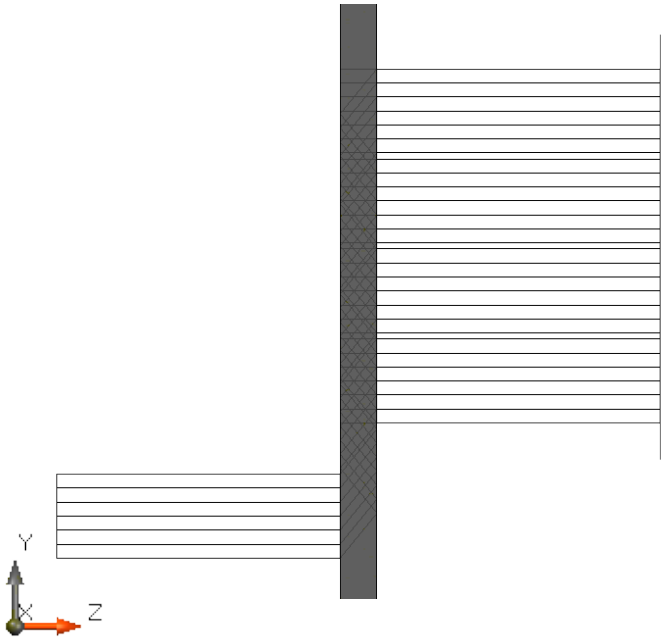
User can specify **energy thresholds** for light paths that can be ignored!

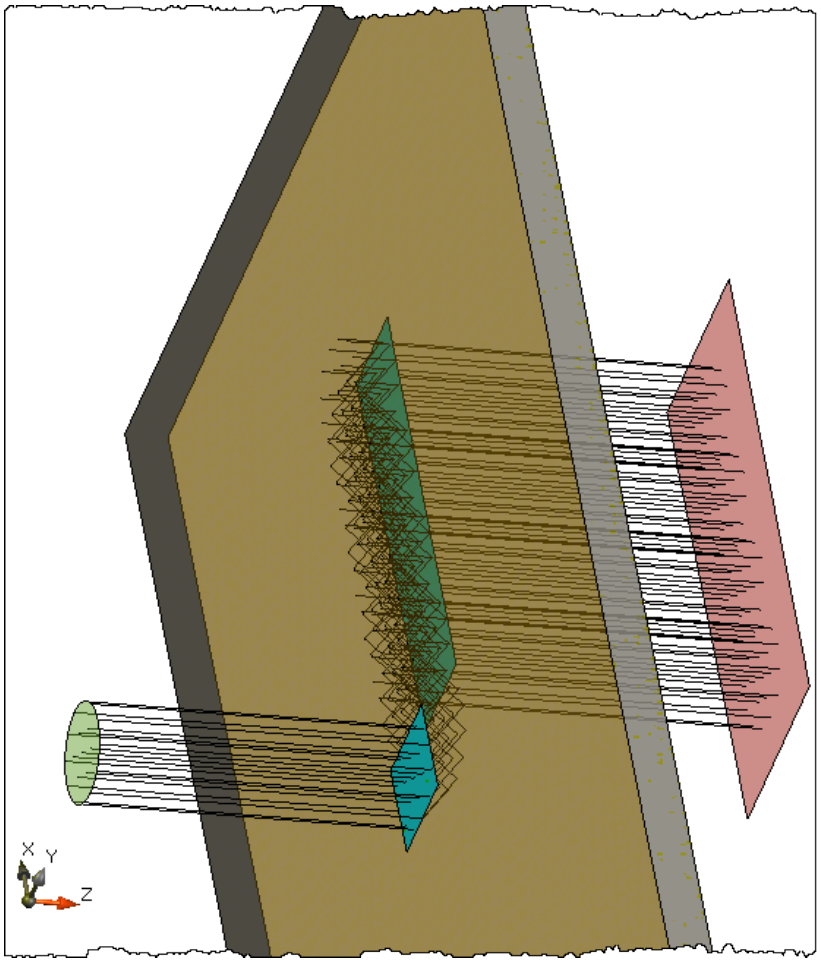
Specifications: Detectors



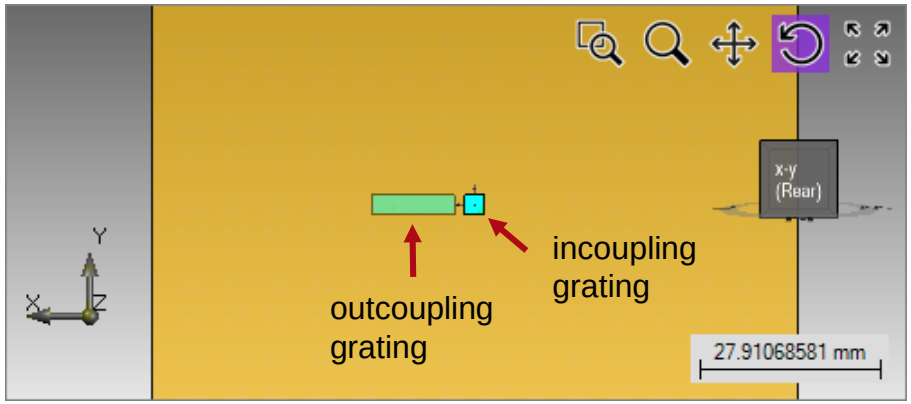
Position	Modeling Technique	Detector/Analyzer
full system	3D ray tracing	3D ray tracing view
a	field tracing	intensity pattern

Results: 3D System Ray Tracing





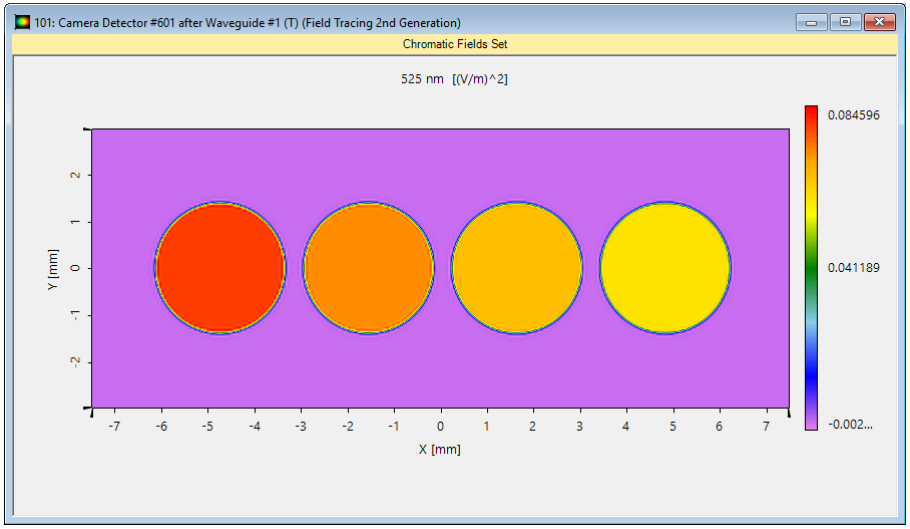
Results: One Outcoupling Grating



Highlights

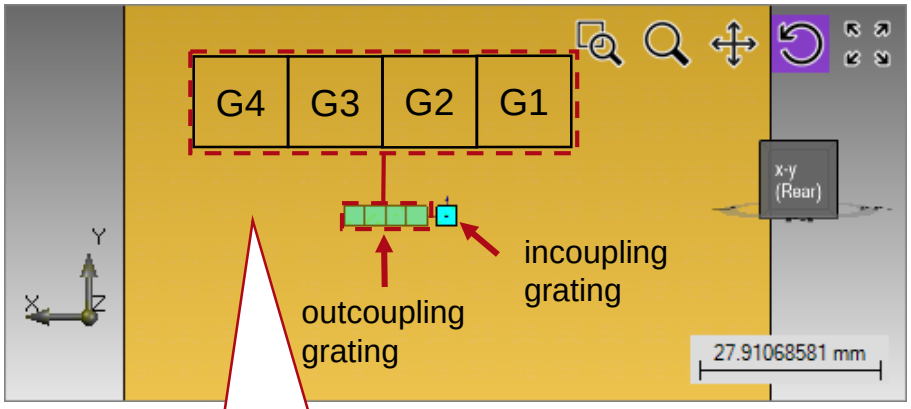
- waveguide simulations including rigorously calculated efficiencies of sub-wavelength grating structures

intensity pattern (false color view)



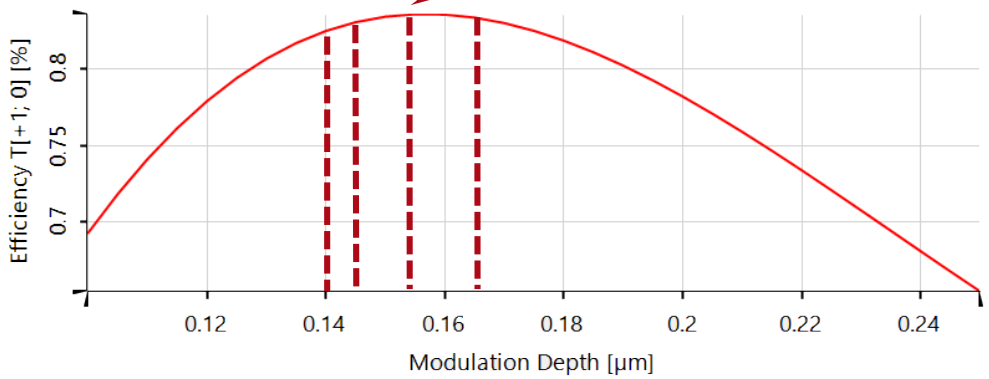
Grating Parameter	Value & Unit
type	sawtooth grating
period	395 nm
height	140 nm

Results: Four Optimized Outcoupling Gratings



segmentation of outcoupling grating

different grating depths of each segment for optimized efficiencies



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- waveguide simulations including rigorously calculated efficiencies of sub-wavelength grating structures
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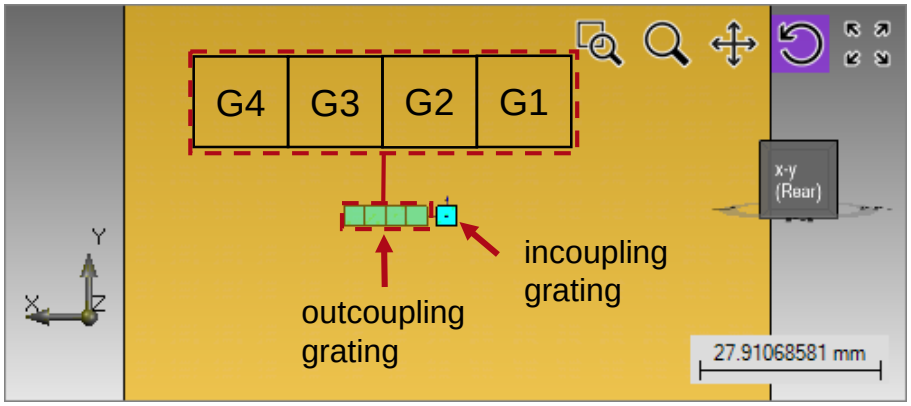
Grating Parameter	Value & Unit
type	sawtooth grating
period	395 nm
depth G1	140 nm
depth G2	145 nm
depth G3	155 nm
depth G4	165 nm

Results: Optimized Output Uniformity



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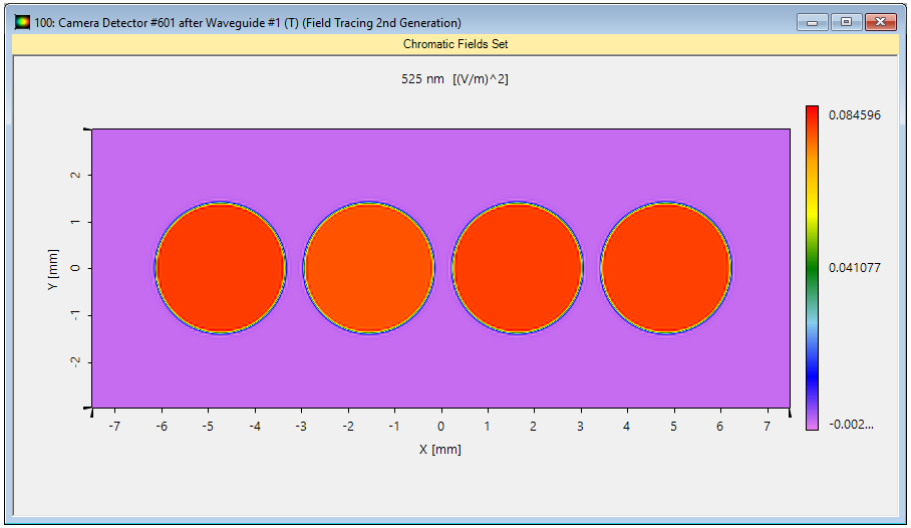

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Document & Technical Info

code	NED.0006
version of document	1.0
title	Waveguide with Uniform Multiple Output Using Rigorously Analyzed Gratings
category	Virtual & Mixed Reality > Near-Eye Displays (NED)
author	Roberto Knoth (LightTrans)
used VL version	7.0.0.29

Specifications of PC Used for Simulation	
Processor	i7-4910MQ (4 CPU cores)
RAM	32 GB
Operating System	Windows 10