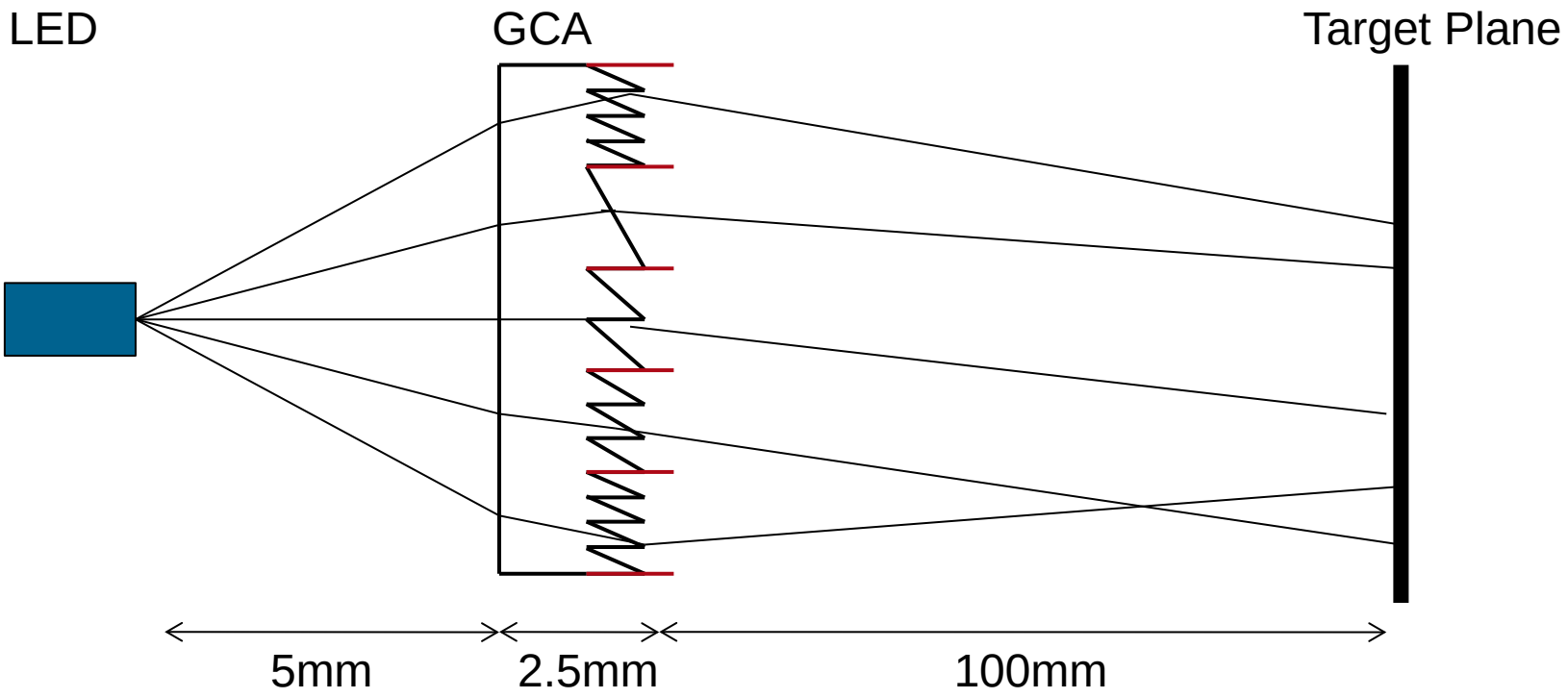
Scenario 317 (2.0)

Design & Analysis of GCA for Cross Pattern Generation with LED Light

Keywords: grating cells array, illumination, diffraction effect

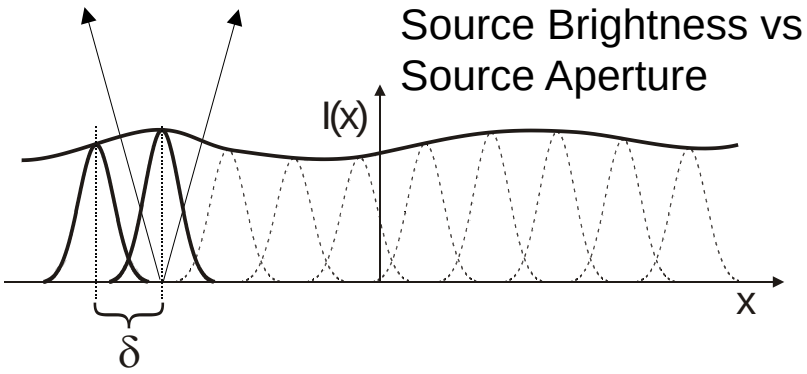
Task Description

This scenario illustrates the design and analysis of a grating cells array (GCA) element for the reshaping of LED light into a cross pattern.



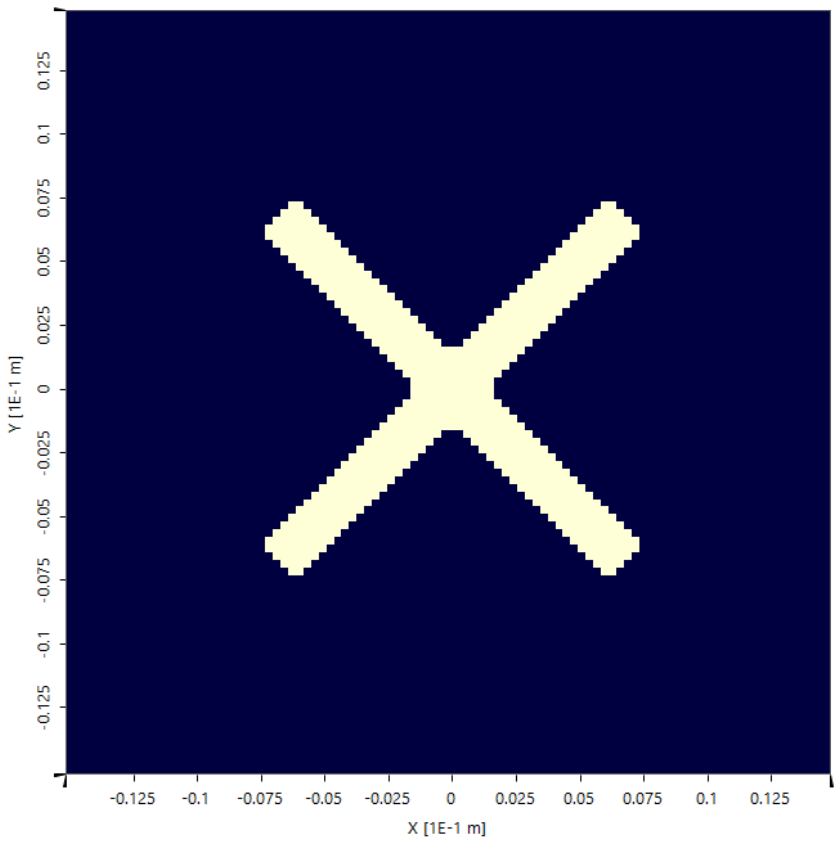
Modeling Task

The shape of the laterl modes define the far field of the light source.



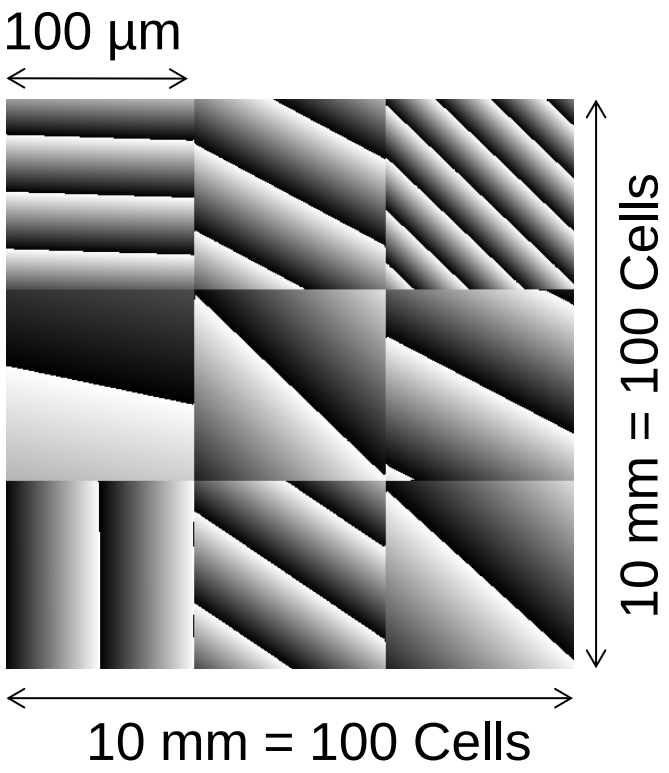
- Planar source is modelled via partial coherent modes:
  - Light described by set of modes.
  - Modes have identical far field shape but different positions, weights and wavelength.
  - Modes are modeled as spherical waves in this example.
- LED parameters:
  - Wavelength 532nm
  - Emitting LED chip size = source plane diameter: 0.1mm x 0.1mm

Modeling Task



- The desire light distribution to be used as Design Target Pattern (DTP) can be specified via bitmap file to be imported.
- The bitmap file of this example represents an area of 30mm x 30mm. The side lengths of the actual target light pattern are: 14.7 x 14.7 mm

Modeling Task



For this example the following parameters are chosen:

- Grating cells array consists of 100cells x 100cells.
- Cell size:
  100 x 100µm
- Array diameter:
  10 x 10 mm

System Setup

- For the design and simulation of this illumination system a specific light path diagram (LPD) is to be used for the description of the optical system.
- Open a new Light Shaping System with Grating Cells via Start ribbon > Lighting item.
- This LPD contains already all base elements for a GCA system.

System Parameter

LIGHT SOURCE PARAMETER	VALUE & UNIT
Size of Source Plane	100µm x 100µm
Wavelength	532nm
Distance to Input Plane	5mm
Input Field Diameter	10mm x 10mm
Sampling Points	201 x 201
Approximated Polarization	circular (right oriented)

GCA COMPONENT PARAMETER	VALUE & UNIT
Thickness of GCA component	2.5mm
Number of Cells	100 x 100
Cell Size	100µm x 100µm

GENERAL SYSTEM PARAMETER	VALUE & UNIT
Distance Diffractive Light Shaper to Target Plane	100mm

Design Settings

- For the design we set the imported and specified target pattern.
- In order to avoid possible pattern effects due to the equidistantly given target pixels, we set the Variability of Spot Positions to 20% x 20%.
- We check the option Apply Random Lateral Shift at Each Grating Cell to introduce an additional irregularity of the phase values.
- For reproducable results we use a fixed seed with value 0 for the random mapping of cells and target position.
- Click 

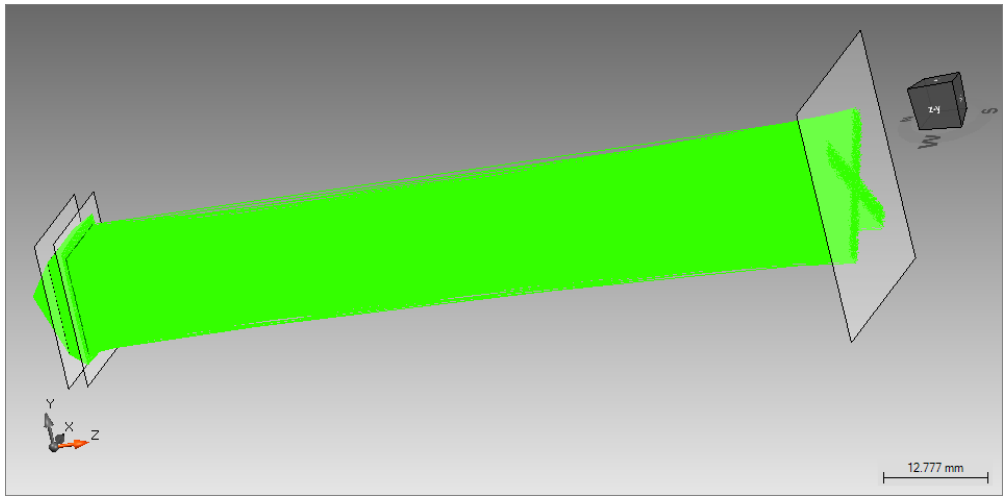
for the design process to start.

Analysis Results of Designed GCA

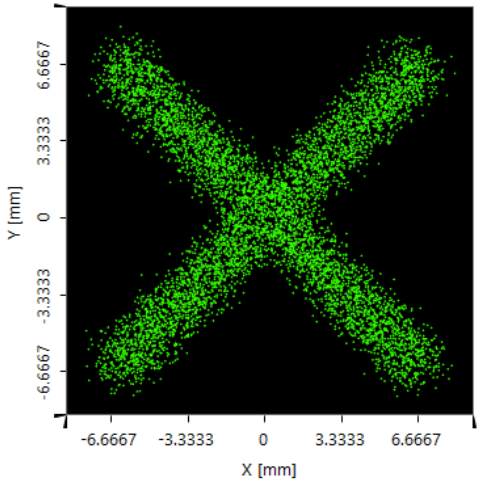
Via Ray Tracing System Analyzer and Classic Field Tracing Engine

File: Sc317_LED2Cross_04_FinalSystem.lpd

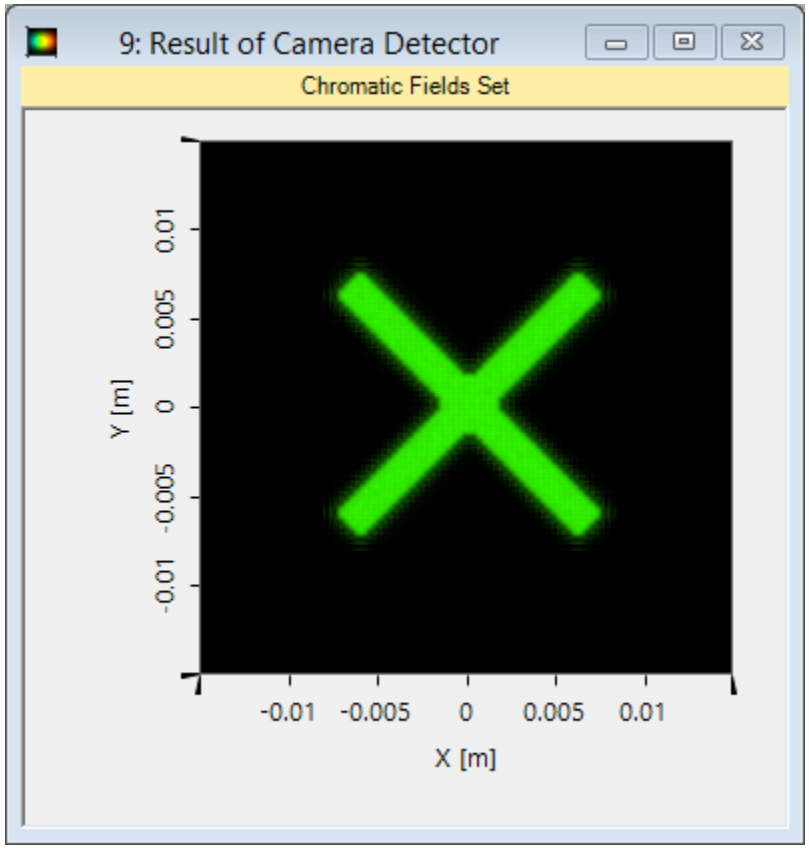
Ray Tracing System Analyzer



Ray tracing does not include diffraction and interference effects.

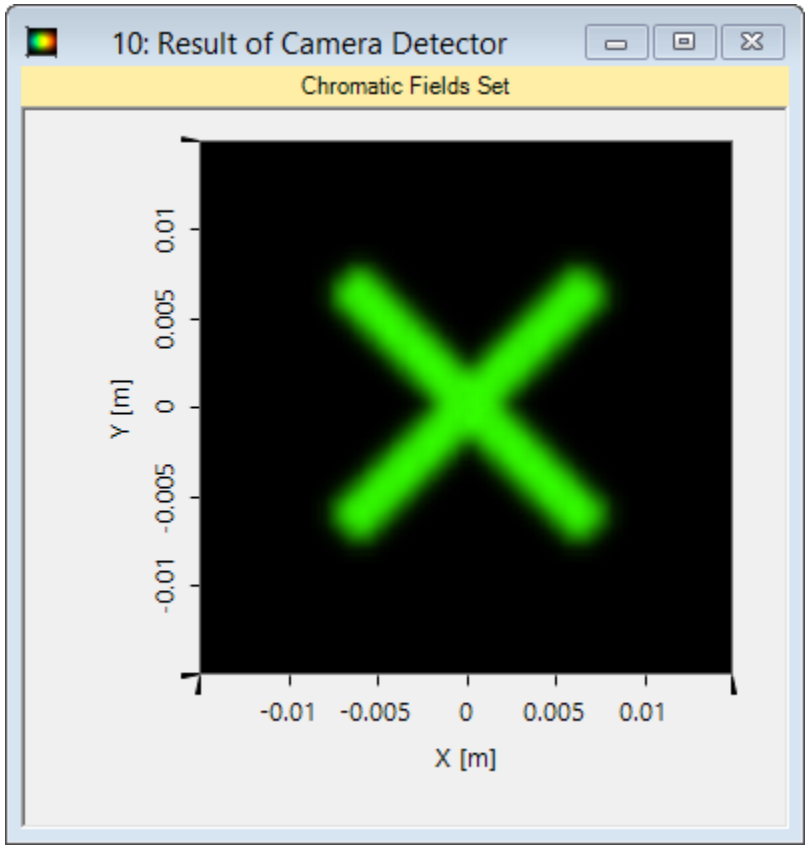


Classic Field Tracing (Central Mode)



- Diffraction, interference and partial coherence effects can be include in the simulation by selecting Field Tracing in the light path diagram.
- The initial setting regards just the +1st diffraction orders and the light source by its central mode.
- Here the camera detector shows an incoherent superposition of all spots generated by the grating cells.

Classic Field Tracing (LED dimension)



- Here the LED is represented by 5x5 lateral modes, simulated the effects due to its actual size.

Export Options

- Analytic parameters of all cells as ASCII data: CSV
- In case of intended binary mask fabrication: GDSII

Summary

- VirtualLab provides a very powerful design approach for illumination systems using micro structured grating cells arrays (GCAs) for light deflection.

- Design and analysis of grating cells arrays can be done including diffraction, interference and partial coherence effects.

- Grating cells arrays can be used to reshape and homogenize LED light.