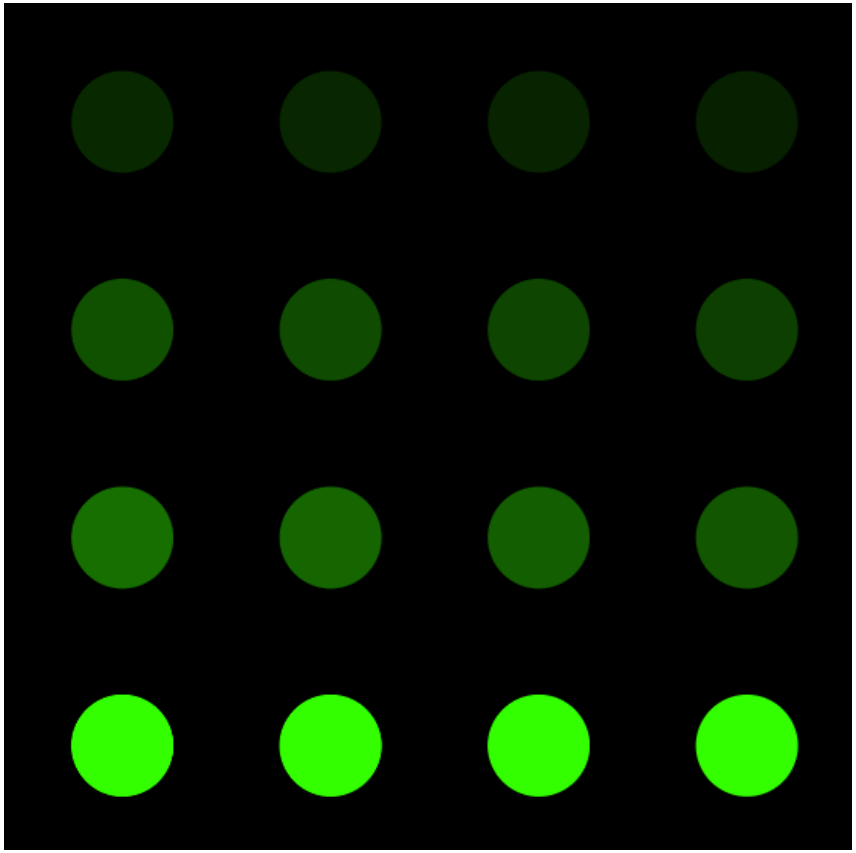
Simulation of Waveguide with a Complex 2D Exit Pupil Expansion

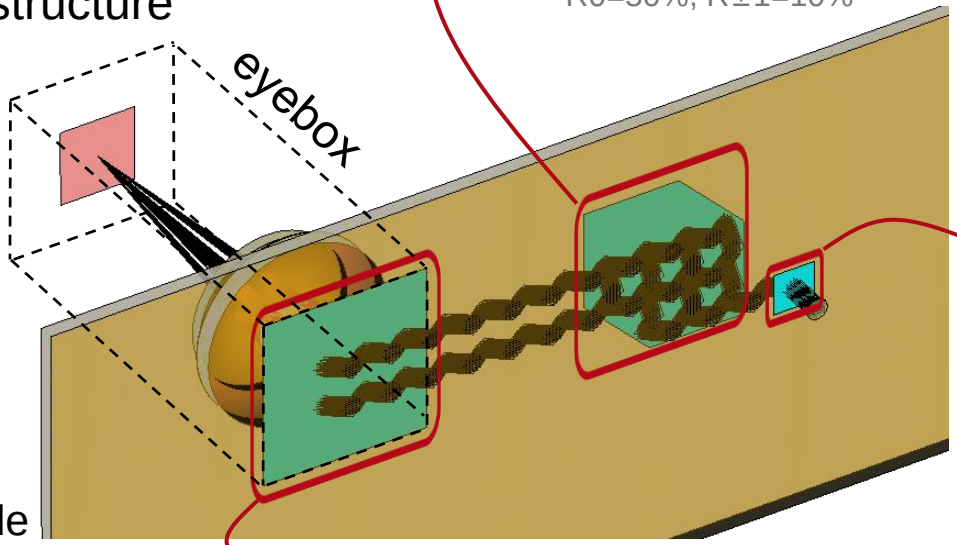
Abstract



Two-dimensional (2D) exit pupil expansion, as a key technology for near-to-eye display, can be realized by using diffractive gratings. Together with the in- and outcoupling gratings, it makes a complex 2D layout on both sides of the waveguide. As an example, a 2D exit pupil expander, which consist of both idealized and real gratings, is constructed and modeled. Uniformity at the exit plane of the waveguide is shown, and the PSF and MTF at the imaging plane are also evaluated.

Modeling Task

How to evaluate the PSF and MTF at the focal plane of the eye, with the complex waveguide structure included?

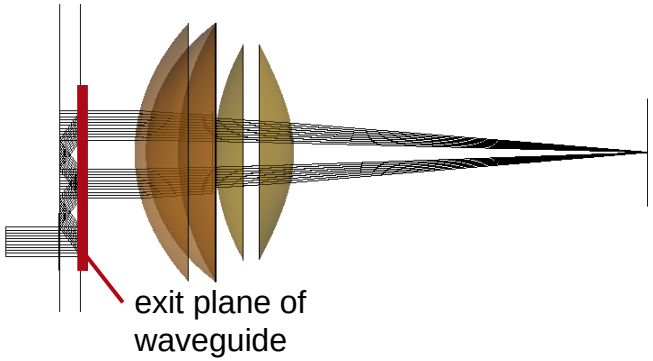


2D pupil expansion grating
- idealized
- period 320.49nm
- rotated by 45°
- diffraction efficiencies R0=50%, R±1=10%

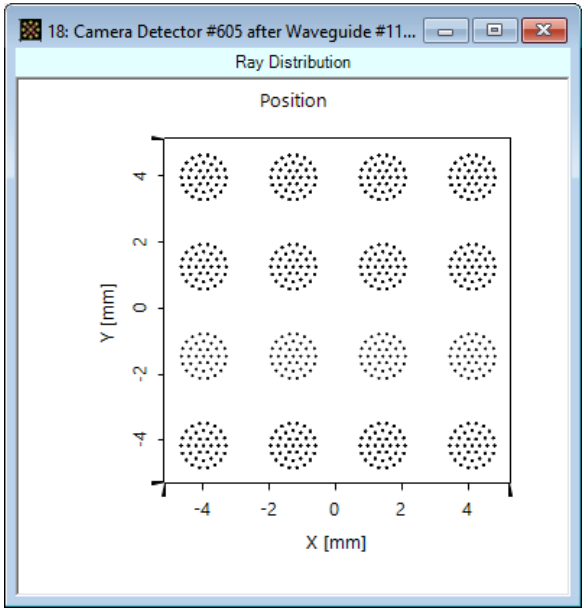
incoupling grating
- idealized
- period 453.24nm
- diffraction efficiency T+1 = 80%

outcoupling grating
- real slanted grating
- period 453.118nm
- slanted angle 35.11°
- fill factor 0.453

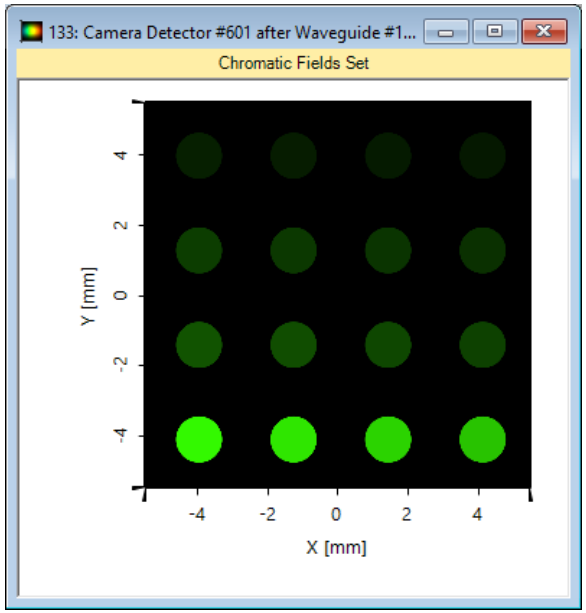
Results



ray tracing spot diagram



field tracing

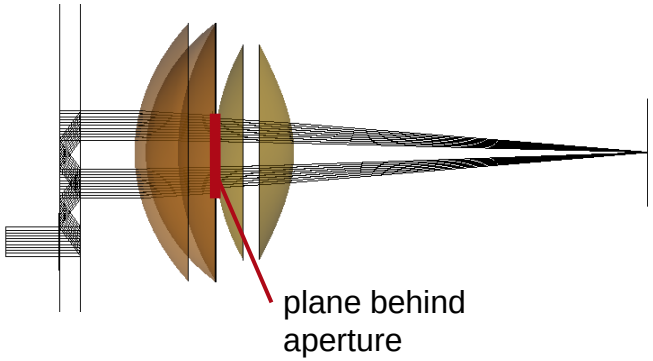


Simulation including

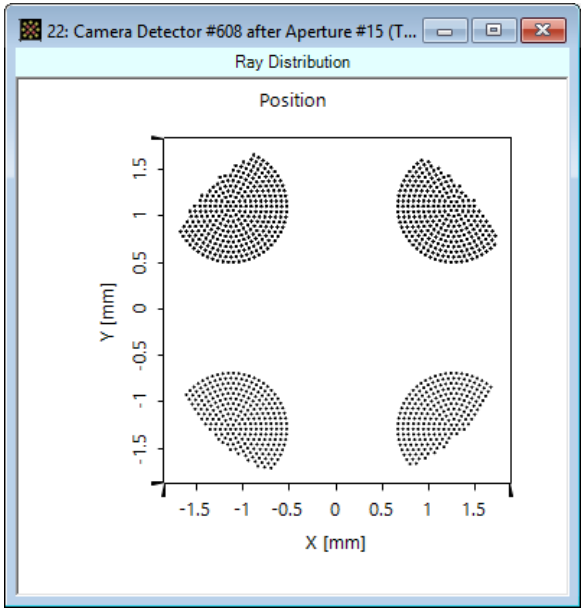
- propagation through waveguide with complex grating configurations
- diffraction efficiency calculation at real gratings by FMM
- multiple diffraction orders

till the exit plane of waveguide, takes less than 10 seconds!

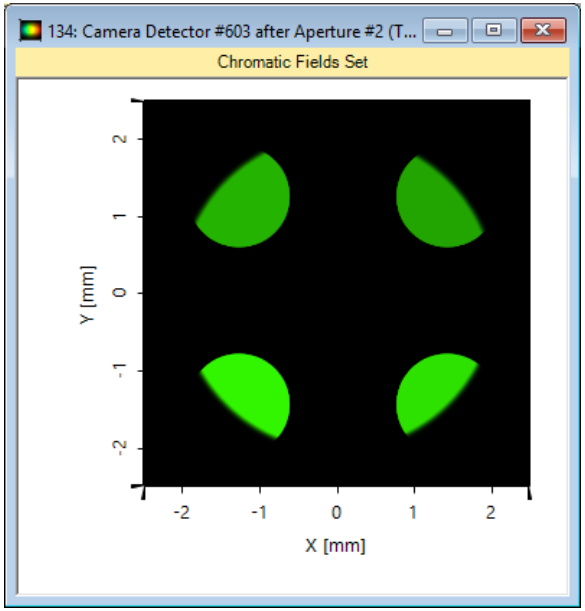
Results



ray tracing spot diagram

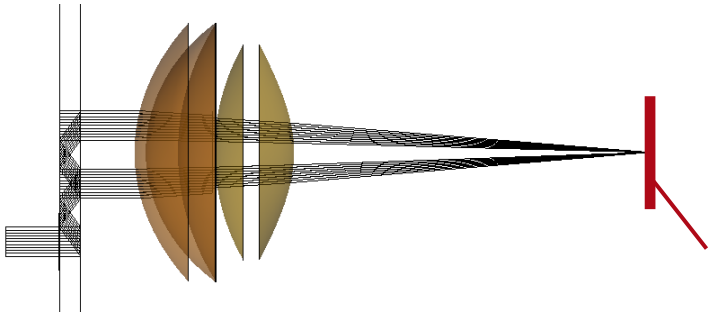


field tracing

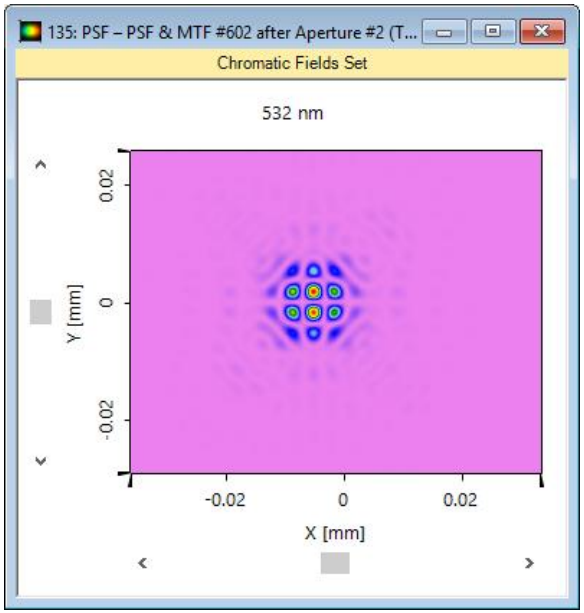


Partially illuminated aperture is taken into account.

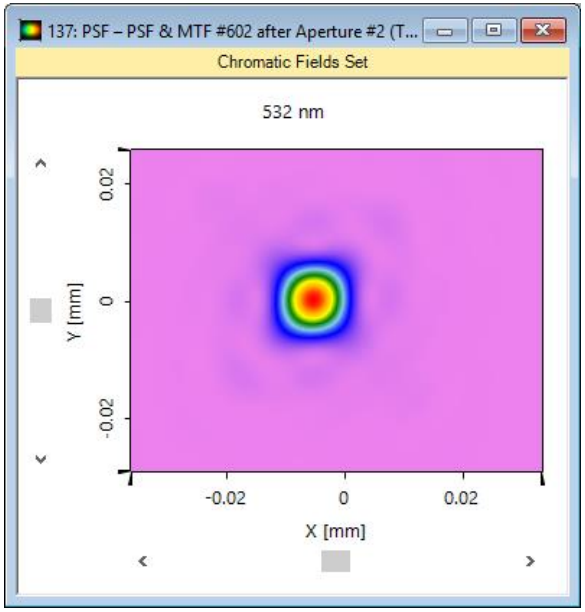
Results



PSF coherent

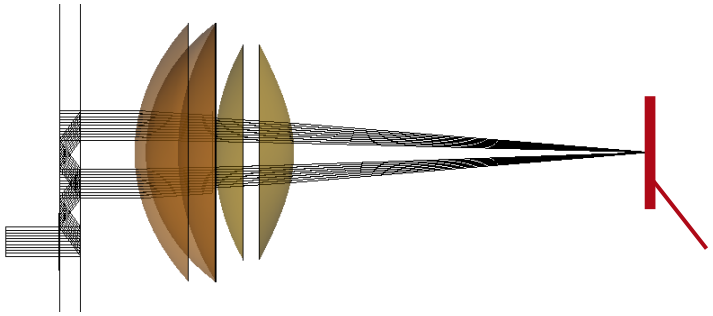


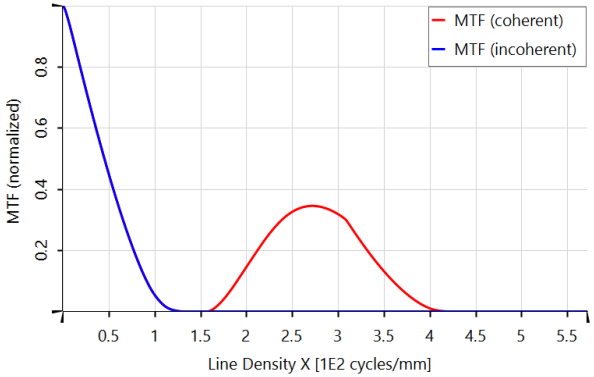
PSF incoherent



Coherence property can also be included.

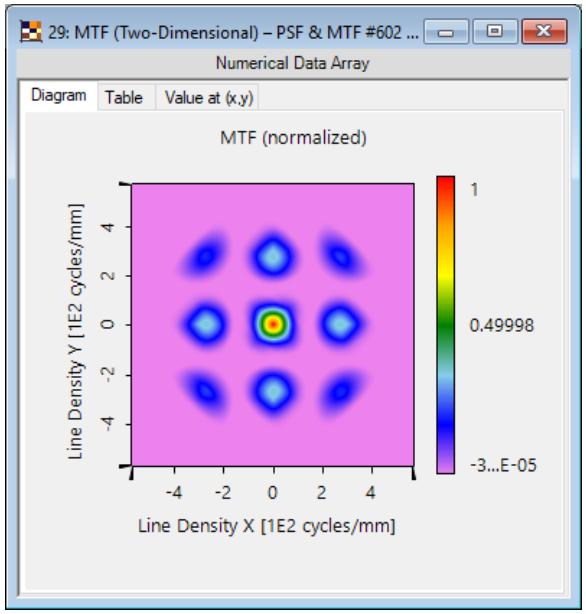
Results



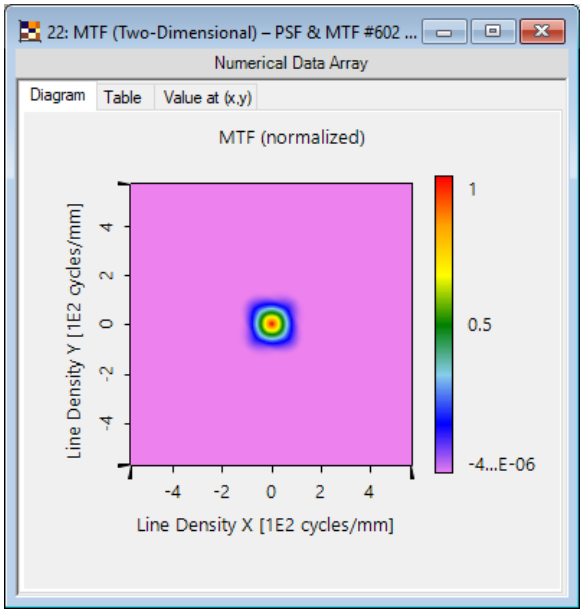


comparison between 1D MTF for coherent and incoherent cases

MTF coherent



MTF incoherent



Document Information

title	Simulation of Waveguide with a Complex 2D Exit Pupil Expansion
version	1.0
VL version used for simulations	7.3.0.41
category	Application Use Case