Polarization-Dependent Binary Resonant Gratings
Polarization-dependent diffraction gratings are found helpful for certain optical metrology systems. According to the work of J. Wüster et al., we construct a grating with sub-wavelength structures following the principle of form birefringence. The grating has a super-period greater than the wavelength, and it shows clearly the polarization dependency: when illuminated with TE polarization, the zeroth order has high transmission efficiency; while for TM case, the ±1 orders have high efficiencies.
How to analyze the resonant diffraction grating rigorously, and to check its performance in the setup, especially with respect to different polarization of light?

Grating parameters follow from J. Wüster, et al., EPJ Web Conf. 238, 05002 (2020)
Grating Property Analysis

The grating diffraction property strongly depends on the input polarization: for TM case the ±1st order has the efficiency of 25% each; for TE case the zeroth order has 58% efficiency.
Field Inside Analysis

- Input field
  - Plane wave
  - Wavelength $\lambda = 1400\,\text{nm}$
  - Normal incidence
  - Linearly polarized (TE or TM)

Check the field distribution inside.

Case with TM input polarization:

Case with TE input polarization:
Field Inside Analysis

For TM polarization, the transmitted phase shows a π-shift between the modulated and unmodulated regions.
Field Inside Analysis

- input field - plane wave
- wavelength $\lambda = 1400\, nm$
- normal incidence
- linearly polarized (TE or TM)

check the field distribution inside

case with TM input polarization

For TE polarization, there is not phase shift between the modulated and unmodulated regions.
Experimental Test Setup

[polarizer (x) with input field]

[polarizer (y)]

[Graphs showing data for Wavelength of 1.4 μm (V/m²)]

-1st order

-1st order

0th order

+1st order
Peek into VirtualLab Fusion

flexible grating definition via programming

visualization of field inside grating structure
Workflow in VirtualLab Fusion

- Construct grating using customized interfaces
  - How to Work with the Programmable Interface & Example (Spherical Surface) [Use Case]
  - Configuration of Grating Structures by Using Interfaces [Use Case]

- Grating modeling within complex system
  - Modeling of Gratings within Optical System - Discussion at Examples [Use Case]
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| further reading | - [Ultra-Sparse Dielectric Nano-Wire Grid Polarizers](#)  
- [Analysis and Design of Highly Efficient Polarization Independent Transmission Gratings](#) |