

Usage of Debye-Wolf Integral Calculator

Abstract



It is well known that the Debye-Wolf integral can be used to calculate the vectorial field near the focal plane in a semi-analytical manner. The Debye-Wolf integral is often used as the basic tool for the analysis of high-NA microscope imaging situations. It is based on an idealized model and therefore it does not require the knowledge on the exact lens specifications for the calculation. This use case will explain how to use the Debye-Wolf integral calculator in VirtualLab Fusion.

Modeling Task



Start the Debye-Wolf Integral Calculator

- We directly click Calculator and choose Debye-Wolf Integral Calculator.
- Next, we set the Light Source, Optical Setup and Numerical Parameters separately.



Light Source – the Input Field

- The wavelength is set here to be 532nm.
- The global polarization is set to be linearly polarized. The angle 0° means the field vector is on *x*-axis.
- One can also choose other type of polarization, e.g. Circularly Polarized, Elliptically Polarized and General Input via Jones Vector.
- The shape of the input field is circular as defined in the Debye-Wolf integral.

🔢 1: Debye-Wolf Integral Calcu	ulator			
Light Source Optical Setup N	umerical Parameters			
Wavelength	532 nm			
Polarization Input				
Type of Polarization Linearly Polarized V				
Angle	0*			
	1: Debye-Wolf Integral Calculator			
	Light Source Optical Setup Numerical Parameters			
Normalized Jones Vector	Wavelength 532 nm			
	Polarization Input			
$\begin{pmatrix} J_X \\ \end{pmatrix} = \begin{pmatrix} \\ \end{pmatrix}$	Type of Polarization Linearly Polarized ~			
(Jλ \	Angle Elistical Angle			
	General Input via Jones Vector			
► C				
Validity: 🕑				
	Normalized Jones Vector			
	$\begin{pmatrix} J_x \end{pmatrix} = \begin{pmatrix} 1 \end{pmatrix}$			
	(_{Jy}) - (_V			
	Create Results			
	Validity: 🕑 Close Help			

Parameters of the Optical Setup

- The refractive index of the focusing region is taken by the real part of the complex refractive index of the materials. Therefore, absorption is not considered.
- The Numerical Aperture is set to be 0.85.
- The Focal Length is set to be 10mm.
- The Distance from Focal Plane to Result Field is set to be 0µm.

1: Debye-Wolf Integral Calculator		
Light Source Optical Setup Numerical Parameters		
Ambient Material		
Name Air	Q	
Catalog Material	× 🥖 🗀	
State of Matter Gas or Vacuum	~	
Numerical Aperture	0.85	
Focal Length	10 mm	
Distance from Focal Plane to Result Field 0 mm		
Create Results		
Validity: 🗸	e Help	

Numerical Settings

- The Field Size is set directly, or by clicking Estimate Field Size button, VirtualLab will make an estimation.
- Sampling Points means the sampling of the resulting fields in spatial domain.
- Number of Directions means the sampling points of the full numerical aperture in angular domain.
- Click Create Results, the electric fields and the energy density is shown.

📃 1: Debye-Wolf Integral Calculator		
Light Source Opti	cal Setup Numerical Paramete	ers
Field Size	2.2907 µm ×	2.2907 µm
	Estimate Field Size	
Sampling Points	128 ×	128
Number of Directions 50 🜩		
	Create Results	
Validity: 🕑		
	C	liose Help

Field and Energy Density Near Focal Plane



1....E-05

-1 -0.5 0 0.5 1 X [μm]

title	Usage of Debye-Wolf Integral Calculator
document code	MIC.0002
version	1.0
toolbox(es)	Starter Toolbox
VL version used for simulations	7.5.0.158
category	Feature Use Case
further reading	 Investigation of Idealized Vectorial Focusing Situation Using Debye-Wolf Integral Analyzing High-NA Objective Lens Focusing