

# PlanOpSim Meta-Component Ray tracing: OpticsStudio interface

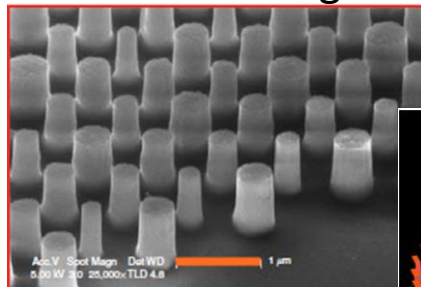


06 June 2023  
EPIC product release

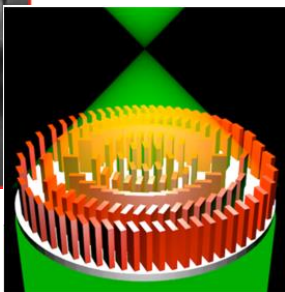


Lieven Penninck – CEO & Founder PlanOpSim

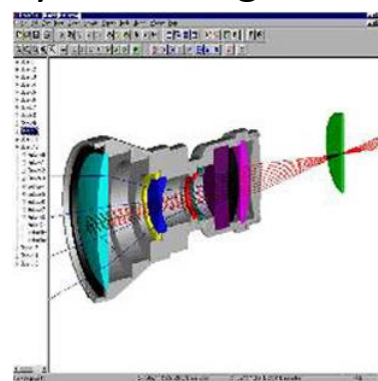
Nano-scale design



Component design



System Integration



**Planopsim's mission**  
Planopsim supplies R&D tools to engineers & scientists that allow to unlock the maximum benefit of flat optics in a user-friendly way.

- ❖ Computer Aided Design software for Planar Optics & metasurfaces
  - All-in-one design workflow
- ❖ Design service for metasurfaces and photonics
  - In-house and 3<sup>d</sup> party tools



# Meta-optics project flow

 **PlanOpSim** Support solution

 **PlanOpSim** Software solution

META CELL

META COMPONENT

LIBRARY

JOB OVERVIEW

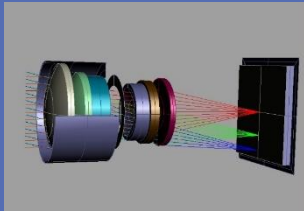
## Concept

- Feasibility
- Specs



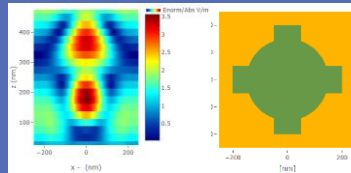
## System model

- Ray tracing



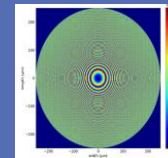
## Nanostructure

- Full wave RCWA
- Structure library



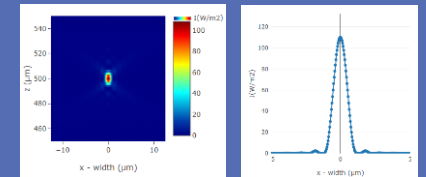
## Component design

- Propagation
- Wavefront design



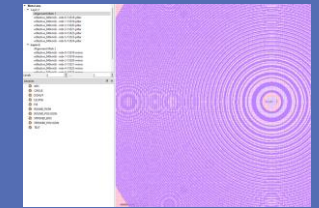
## Validation

- Propagation
- Non-idealities



## Fabrication

- gds export



REPORT

MASK

## Customers: software & design services



MORROW



## User feedback

Thank you very much! I'm **really enjoying the application** already, the examples are great. The metacell portion is **very intuitive** for anyone familiar with modeling periodic structures.

I found the PlanOpSim Software **most useful and appropriate for designing metalenses**. It really helped me to design the required lenses **with ease and instantaneous results**. We would like to continue using the software for our research. We are interested in both meta cell and meta component modules.

I think the software is a **real time saver**, I will be happy to use it in the future, thanks again!

# Unique tool for meta-surface design



	PlanOpSim	Ansys Lumerical	LightTrans	Synopsys
<b>CLOUD OR LOCAL</b>	✓	✗	✗	✗
<b>INTUITIVE LEARNING CURVE</b>	✓	✗	✗	✗
<b>LARGE AREA</b>	✓	✗	✗	✗
<b>INTEGRATION WITH RAY TRACING</b>	✓	✓	✓	✓
<b>SCRIPTING</b>	✓	✓	✓	✓
<b>EXPORT TO MANUFACTURING</b>	✓	✗	✓	✓
<b>FULL METASURFACE WORKFLOW</b>	✓	✓	✗	✓
<b>DEDICATED META-SURFACE SUPPORT</b>	✓	✗	✗	✗

- ❖ Dedicated meta-surface UI and design workflow
- ❖ Multi-scale simulations from nano- to macroscale
  - Meta-atom -> full wave RCWA
  - Components -> Physical optics
  - Systems -> Integration to ray-tracing (new June 2023)
- ❖ High speed simulation

# What's new?!

Beta-test OpticsStudio interface: June 13 2023!!!

- ❖ **New features**
- ❖ **Large area design:** Meta-components up to 169'000'000 meta-atoms (6,3x6,3mm<sup>2</sup>)
- ❖ **Batch selection** of meta-atoms
- ❖ **Angular analysis** and optimization
- ❖ **Wave-to-ray interface**
  - Direct export to OpticStudio
  - Efficient DLL computation
  - Straightforward workflow
- ❖ **Supported applications:**
  - Hybrid meta-system design
  - Dispersion engineering
  - Angle dependence of meta-surfaces
  - Sequential and non-sequential mode

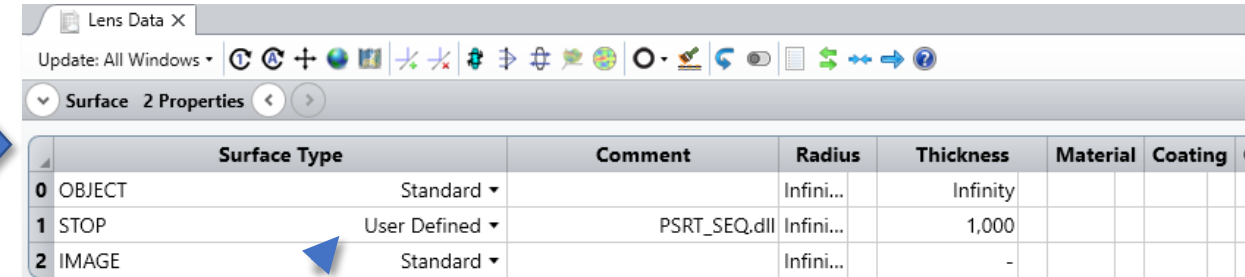
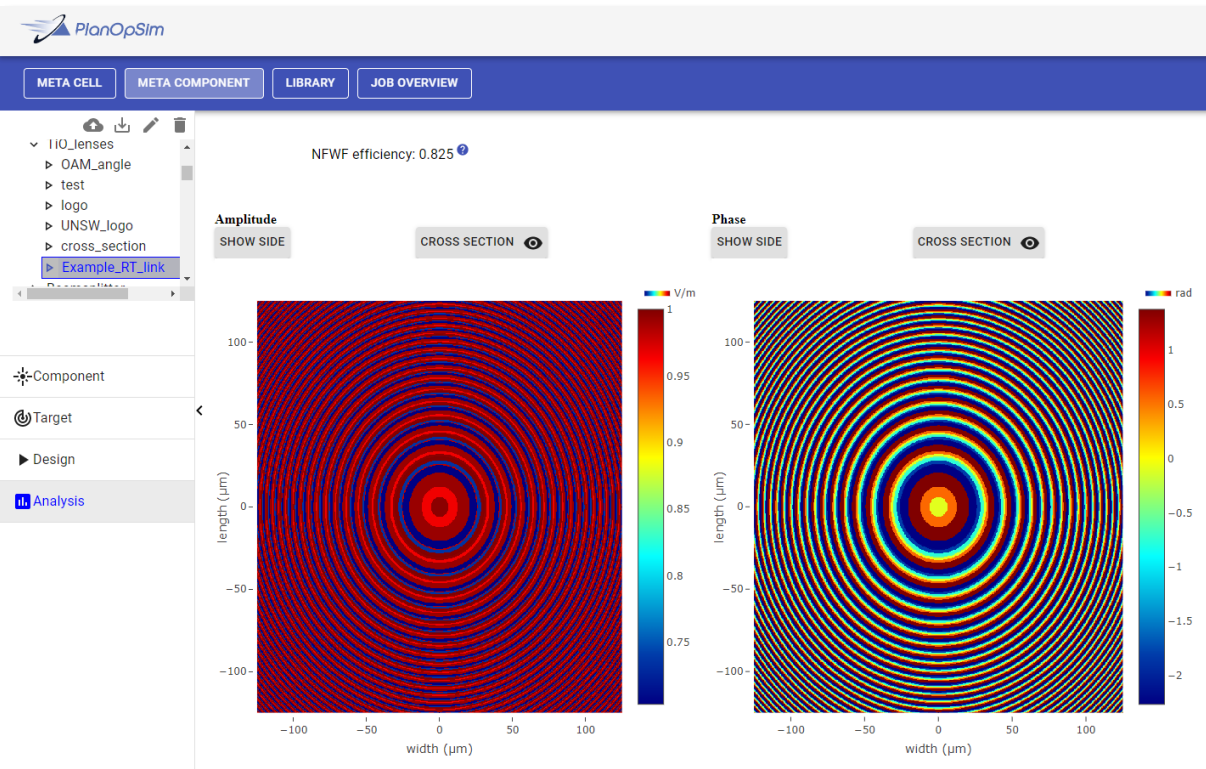


The screenshot displays the PlanOpSim software interface. At the top, there are navigation tabs: META CELL, META COMPONENT, LIBRARY, and JOB OVERVIEW. The main workspace shows a 'Result' section with three wavefront plots: 'Input wavefront (rad.)', 'Reconstructed wavefront (rad.)', and 'Error wavefront (rad.)'. Below these plots, it indicates 'Phase cross section RMSE 1.0e-06'. On the right side, there are buttons for 'NEW RAY TRACING LINK', 'UPDATE RAY TRACING LINK', 'EXPORT RAW DATA', and 'EXPORT PSRT FILE'. The bottom section contains several configuration panels: 'Sweep Variables' (with a table), 'Incident Light' (with fields for Amplitude, Wavelength, Unit, Type, Azimuth, Zenith), 'Outgoing conditions' (with Order X and Order Y), 'Polarization Combinations' (with Polarization in, Polarization out, and Direction), 'Meta Cell Accuracy' (with Accuracy X and Accuracy Y), and 'Decomposition settings' (with Polynomial, Max nr. of polynomials, and RMSE Threshold).

Actions	Alias	Parameters/Formula
 	wl_sweep	0.45;0.95;0.1

Polynomial	Max nr. of polynomials	RMSE Threshold
Zernike	14	1e-9

## PlanOpSim: metasurface design & wavefront analysis

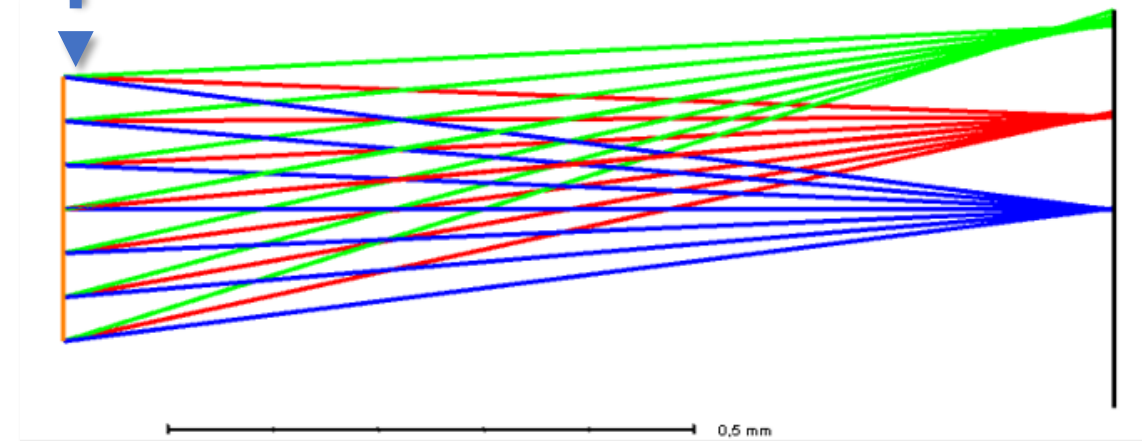


The screenshot shows the 'Lens Data X' window in OpticsStudio. It features a toolbar with various icons for navigation and editing. Below the toolbar, there is a section for 'Surface 2 Properties' with navigation arrows. The main part of the window is a table with the following data:

	Surface Type	Comment	Radius	Thickness	Material	Coating
0	OBJECT	Standard	Infini...	Infinity		
1	STOP	User Defined	Infini...	1,000		
2	IMAGE	Standard	Infini...	-		

Imported meta-surface

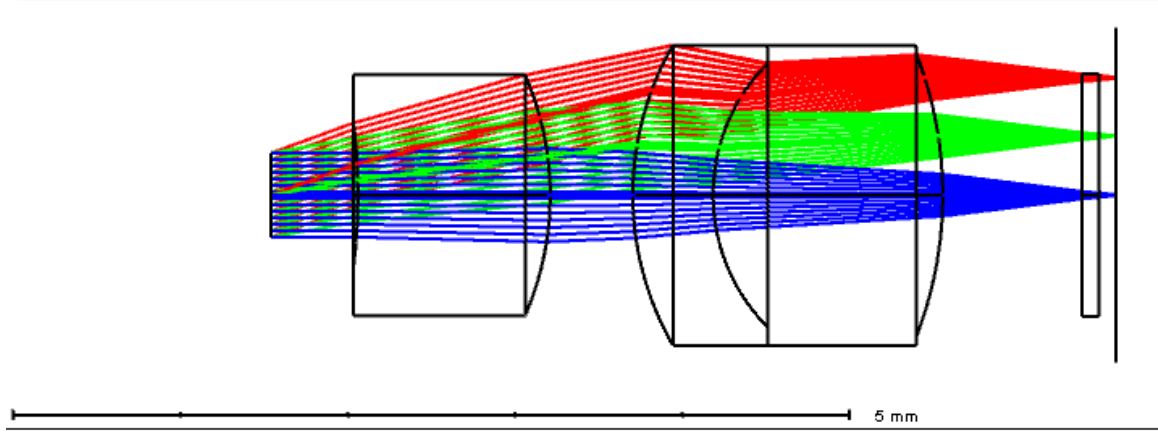
Meta-surface response in ray tracing



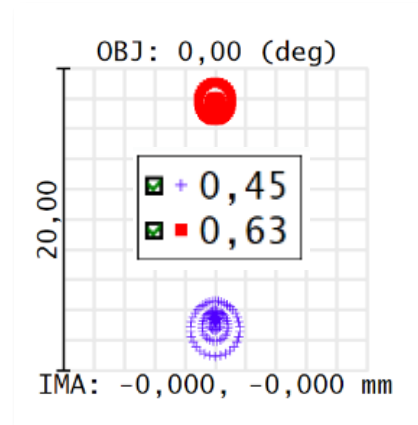
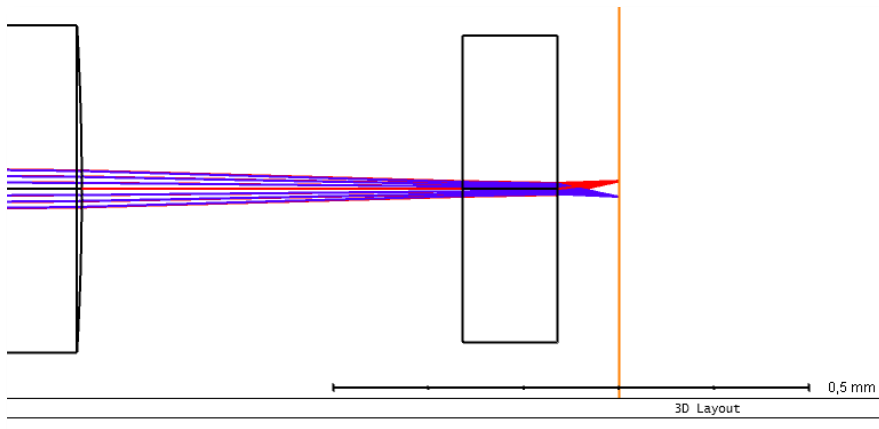
- ❖ Meta-surface design in PlanOpSim:
  1. Design
  2. Decompose
  3. Export PSRT & DLL
- ❖ Meta-lens import to OpticsStudio

# Meta-surface in system

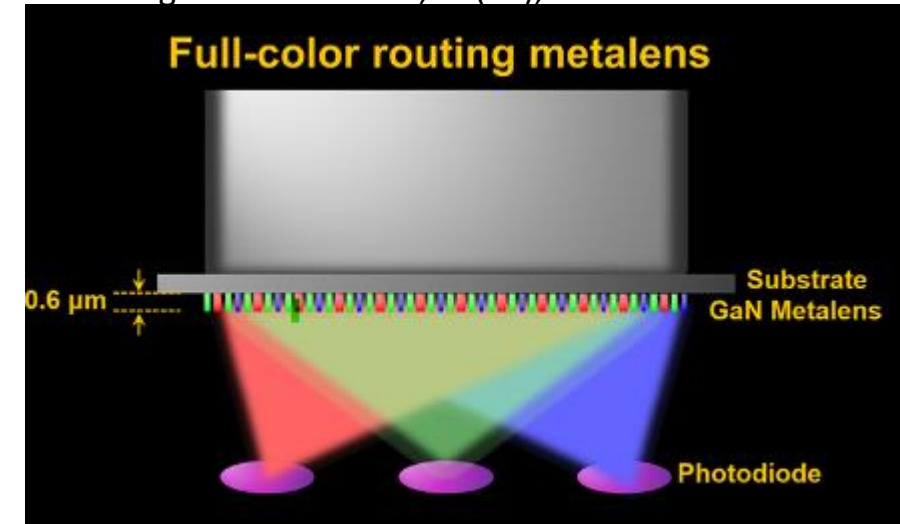
- ❖ Example: **Pixel level colour routing in system**  
Classical design: telecentric imaging system



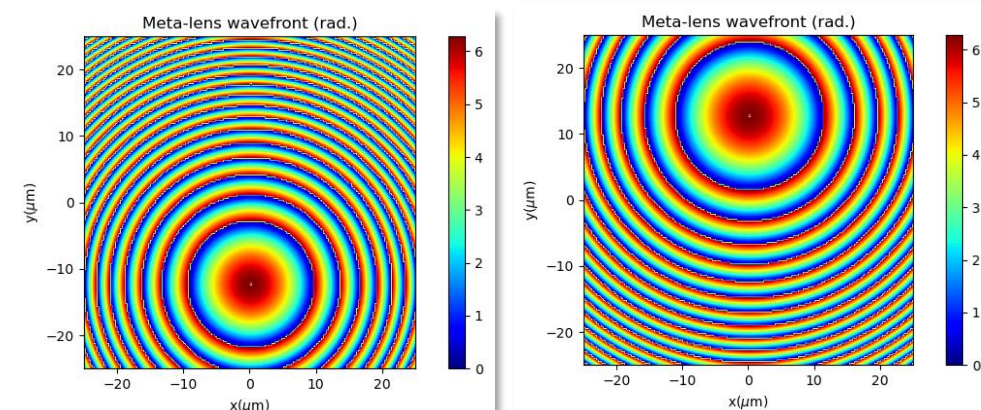
- ❖ Colour multiplexing meta-lens **designed and exported from PlanOpSim**



\*Based on: GaN Metalens for Pixel-Level Full-Color Routing at Visible Light. *Nano Letters*, 17(10), 6345–6352.



Wavelength multiplexed meta-lens







Contact us to participate in Beta test!

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