Design Queries

Use Design Query to find the structure parameters required to realize a desired phase transition and evaluate the resulting design quality.

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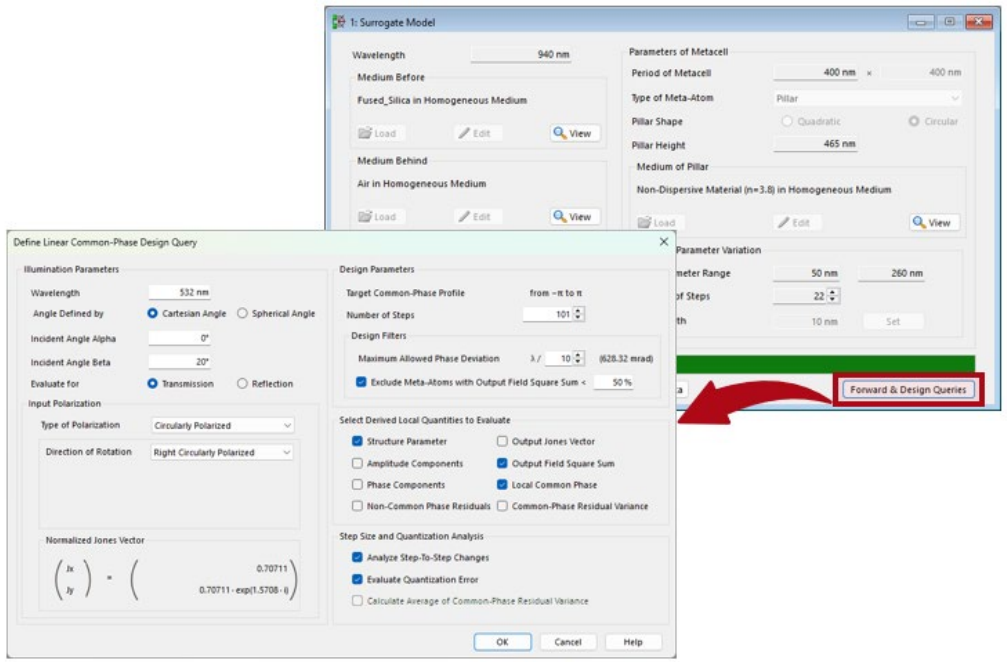
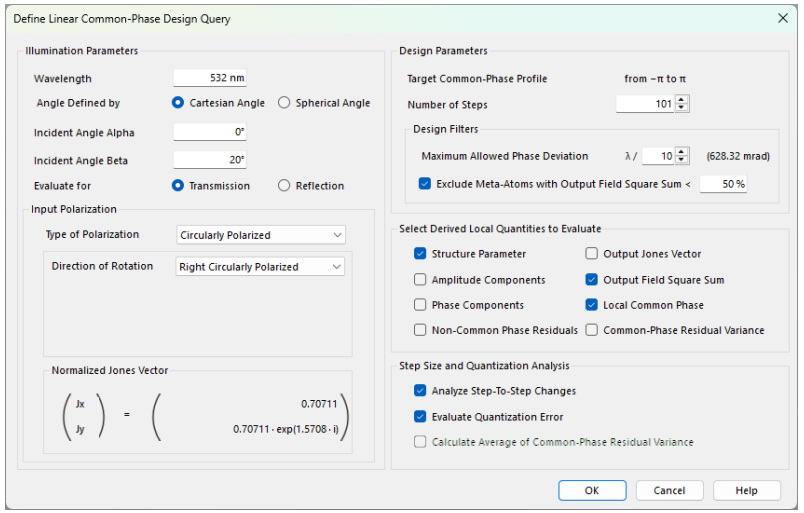


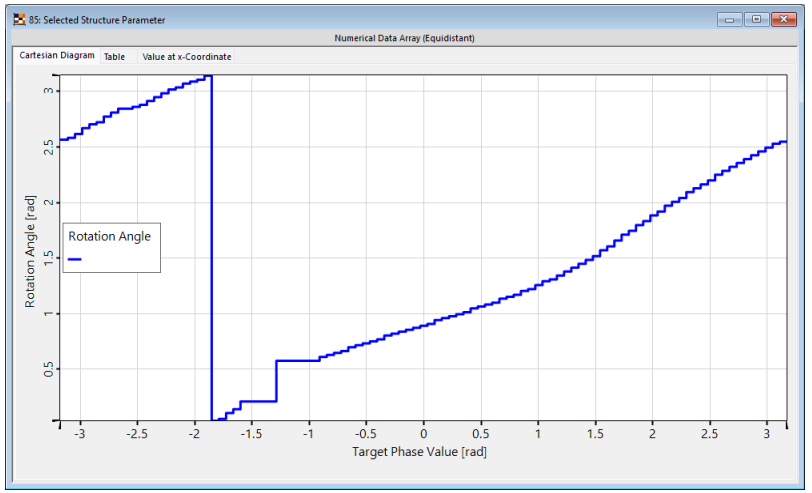
What Can Design Queries Be Used For?

⚠ From Target Phase to Structure Parameters

- Design Query works in the inverse direction of a Forward Query.
- The user specifies a desired Local Common Phase value.
- The tool finds the structure parameter that best realizes this target phase.

Get more information about our Surrogate Models ***here!***



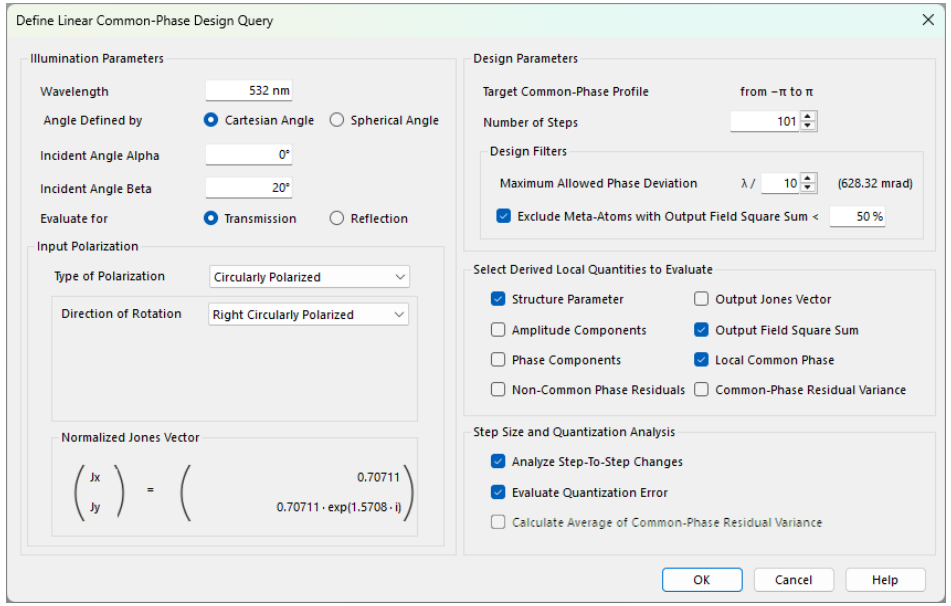


Rotation angle vs target phase

Demo Surrogate Model Investigation

Surrogate Model Parameters

Parameter	Value
Type	Nanofins
Wavelength	532 nm
Polarization	Right circular polarisation
Incidence angle range	-20° - 20° (11 × 11 steps)



Design Query

Varied parameter	Value
Incident angle alpha	0°
Incidence angle beta	- 20°
Maximum allowed phase derivation	λ / 10
Exclude Meta-Atoms with Output Field Square Sum <	50 %

Please find the surrogate model in the corresponding files as:
Surrogate_Nanofins.sur

There are no OS-files necessary to repeat the content of this feature demonstration.

Results

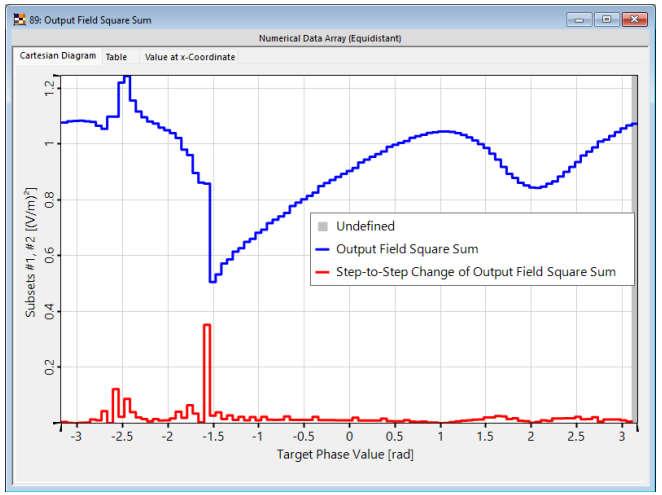
Main Observation

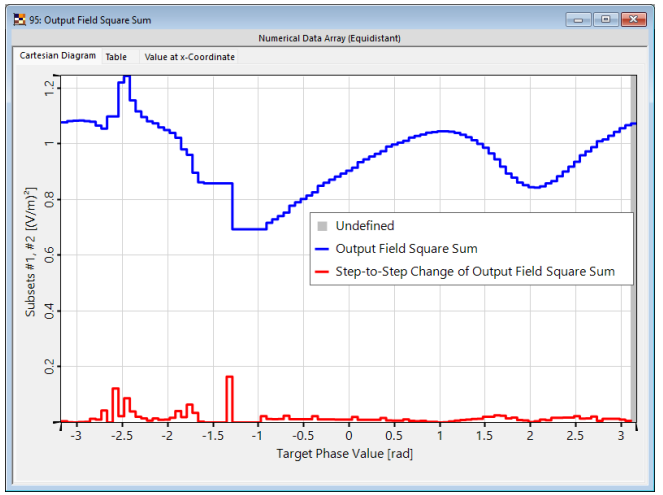
- The Design Query returns the rotation angles required to generate the $-\pi$ to $+\pi$ phase transition.
- The Local Common Phase follows the target phase well.
- The Output Field Square Sum reveals a clear dip near a target phase of about -1.3 rad.
- This resonance can be filtered away, improving overall efficiency on the cost of phase effects.

Without filter

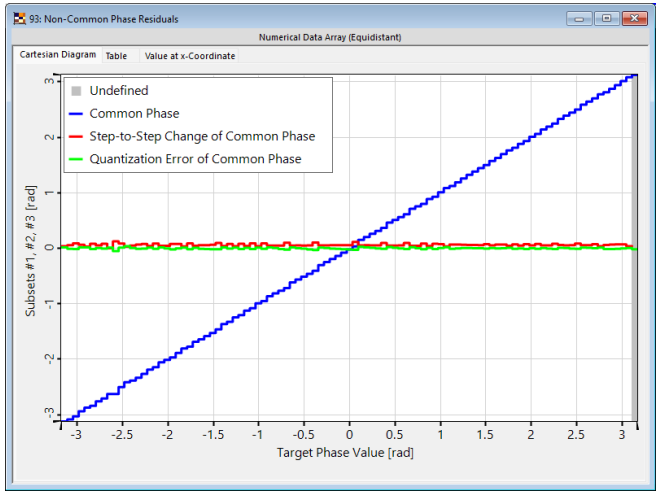
Without filter

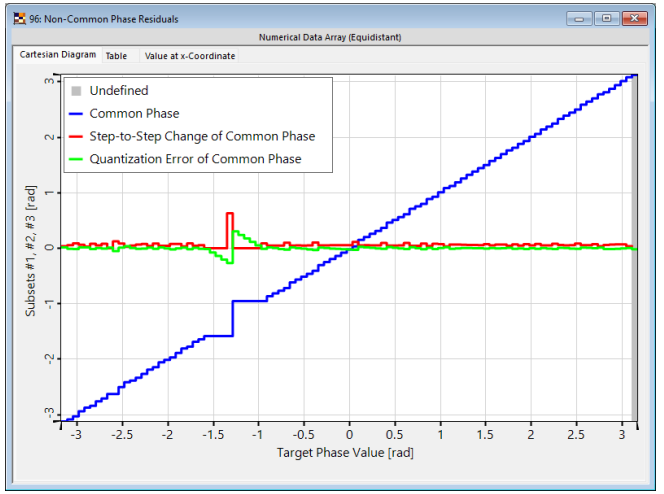
Output field square sum





Local Common Phase Residuals





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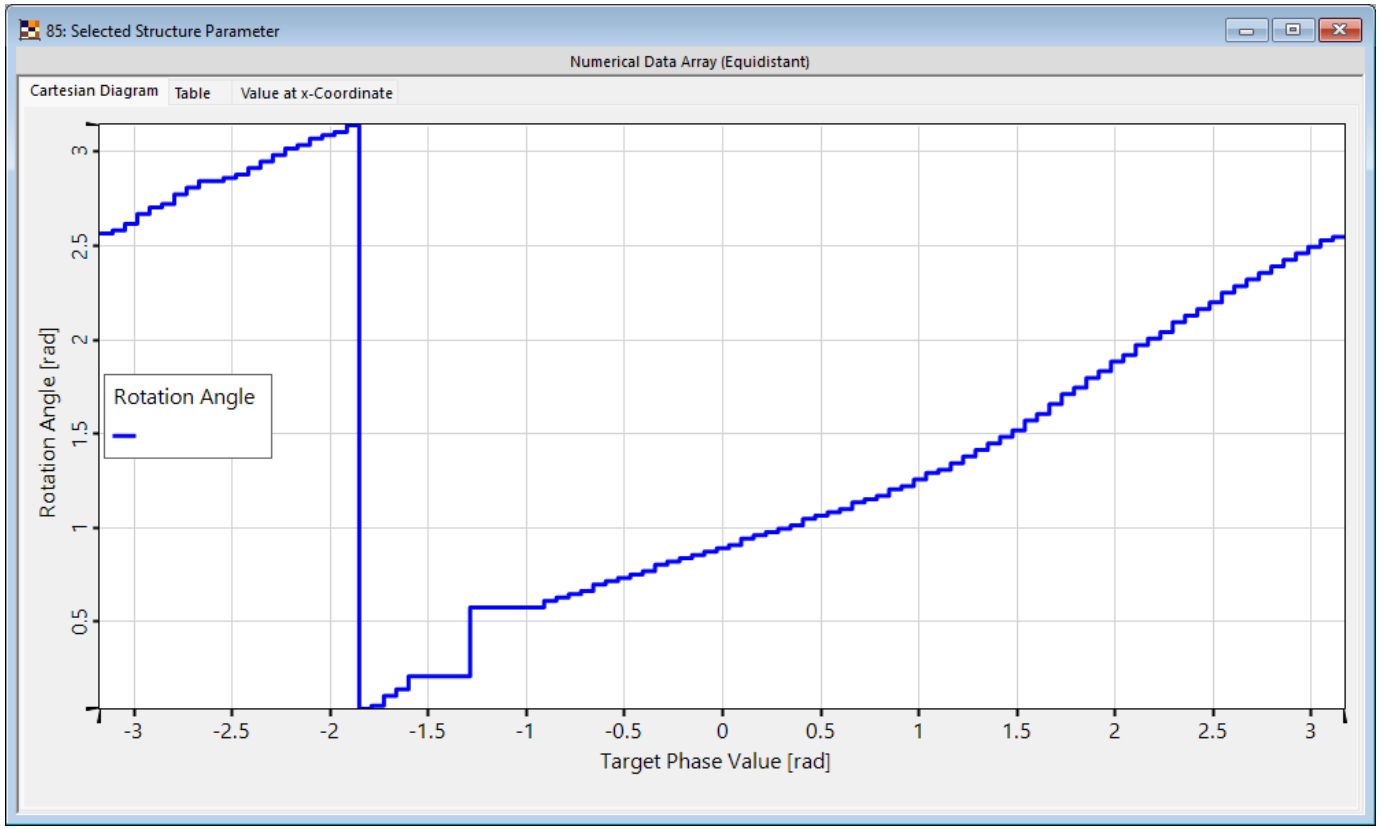
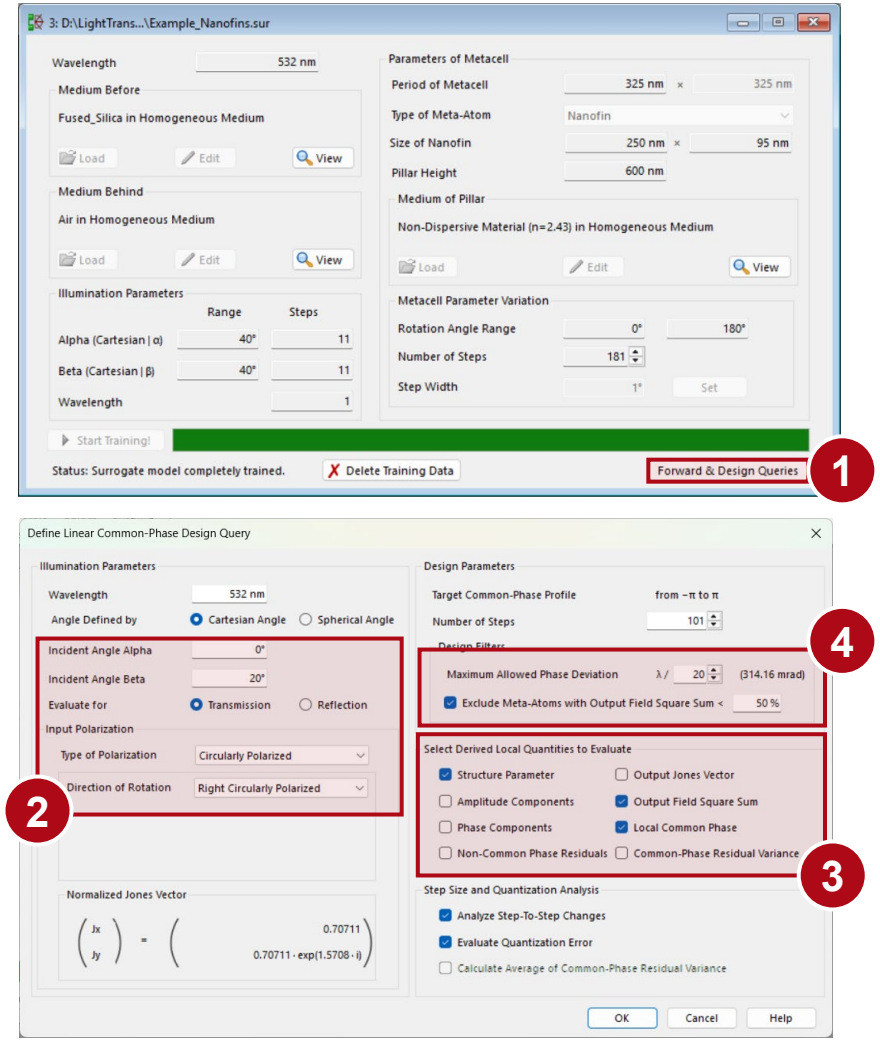


Rotation angle vs target phase value

Workflow

What the User Does

1. Open the surrogate model file with the pre-trained nanopillar surrogate model.
2. Click *Forward & Design Queries*. Pick *Design Related Scan*.
3. Choose *Right Circular Polarization* and $20°$ *Incident Angle Beta*.
4. Select *Output Field Square Sum* and *Local Common Phase* and *Local Common Phase* as outputs.
5. Press *OK*
6. Repeat the previous steps but this time also active *Exclude Meta-Atoms with Output Field Square Sum* and set it to 50%



Related Documents

White Papers

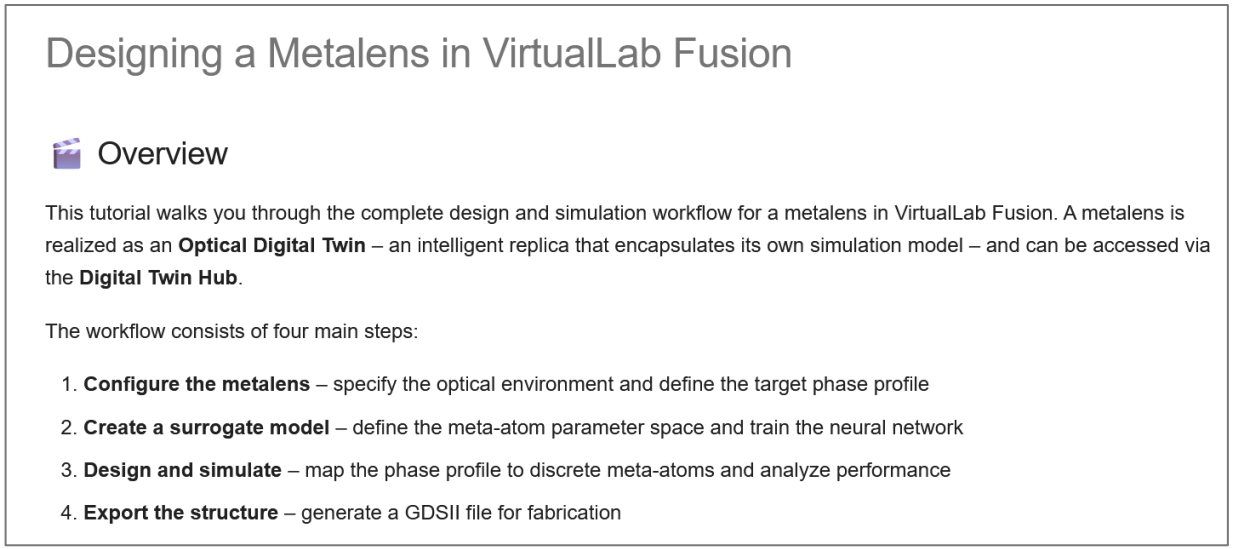
- WP-META-SURROGATE — Surrogate Modeling: Enabling Practical Metalens Design and Simulation
- WP-META-PHASE — Designing and Analyzing the Phase Response of Metasurfaces

Use Cases and Feature Demos

- Collimation with a Metalens Based on Nanopillars
- Aberration Control via Metalens
- Wavefront Phase Modifier Twins
- Forward Queries

Tutorials

- Designing a Metalens in VirtualLab Fusion



Designing a Metalens in VirtualLab Fusion

Overview

This tutorial walks you through the complete design and simulation workflow for a metalens in VirtualLab Fusion. A metalens is realized as an **Optical Digital Twin** – an intelligent replica that encapsulates its own simulation model – and can be accessed via the **Digital Twin Hub**.

The workflow consists of four main steps:

1. **Configure the metalens** – specify the optical environment and define the target phase profile
2. **Create a surrogate model** – define the meta-atom parameter space and train the neural network
3. **Design and simulate** – map the phase profile to discrete meta-atoms and analyze performance
4. **Export the structure** – generate a GDSII file for fabrication