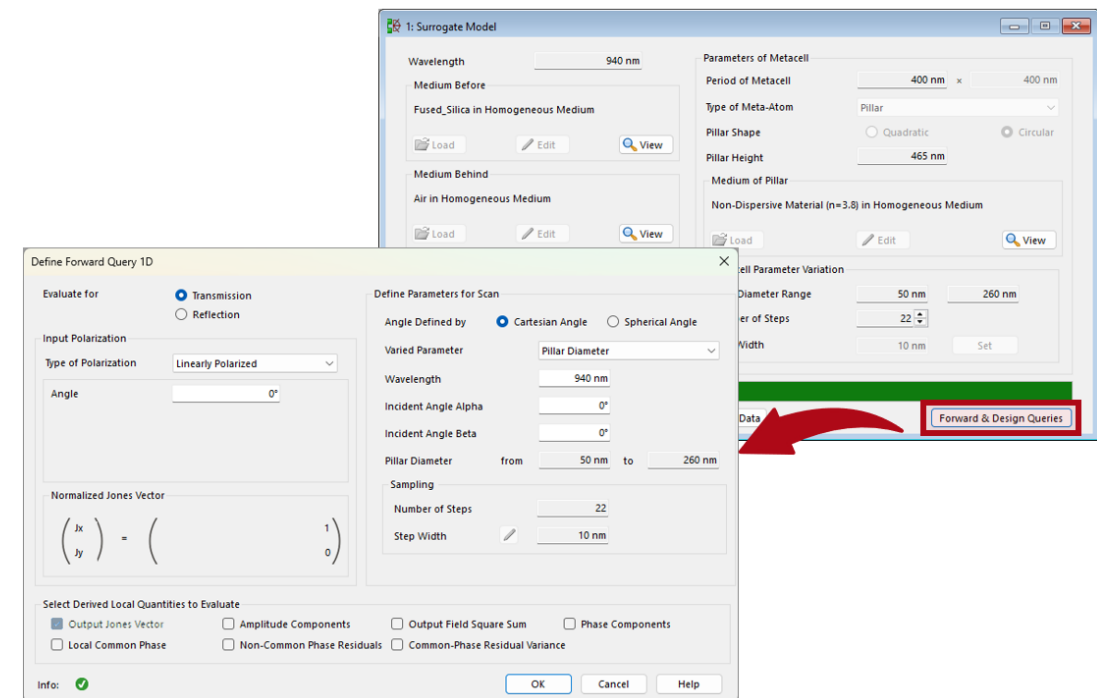


Use Surrogate Model Forward Queries to Predict Meta-Atom Responses

Document ID: FD-META-FORWARDQ
Version: 1.0
Date: August 12, 2026
Author: LightTrans International GmbH
Version: 2026.2
Package: Flat Lens Package



What Can Forward Queries Be Used For?

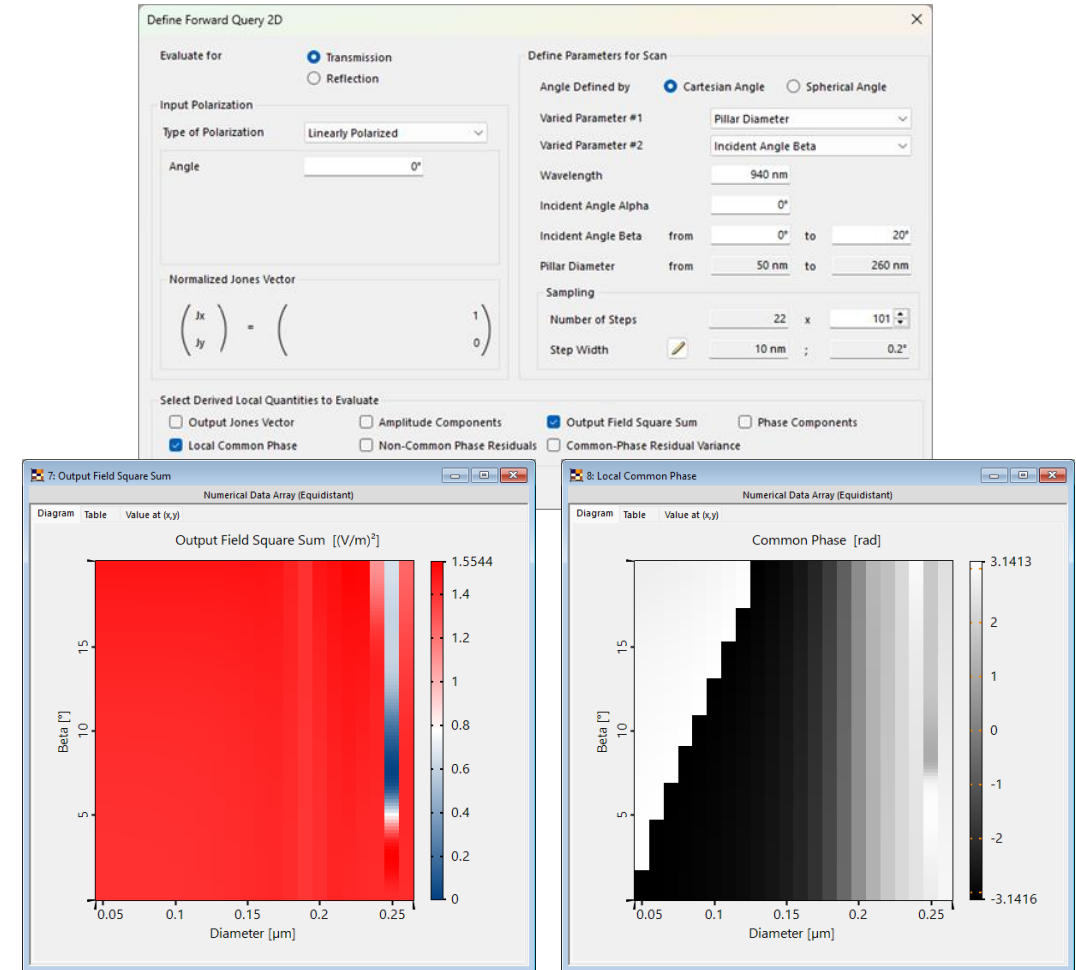
💡 Easy Inspection of Surrogate Models

- Forward Query provides direct and instant access to the response of a trained surrogate model - no design or simulation required.
- Users can inspect how the response changes with input parameters such as angle, wavelength, polarization, and geometry.

📈 Typical Applications

- Identify critical parameter regions, such as resonances or efficiency drops.
- Support early design decisions before evaluating the complete optical system.

Get more information about our Surrogate Models [here!](#)



Output field square and local common phase of the surrogate model.

Demo Surrogate Model Investigation

📈 Surrogate Model Parameters

Parameter	Value
Pillar diameter range	50 nm – 260 nm (10 nm stepsize)
Wavelength	940 nm
Polarization	Linear x-polarization
Incidence angle range	-20° - 20° (11 × 11 steps)

📈 Forward Query

Varied parameter	Value
Pillar diameter	50 nm – 260 nm
Incidence angle	0° - 20°

Please find the surrogate model in the corresponding files as:

Surrogate_Nanopillars.sur

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

Define Forward Query 2D

Evaluate for: ☒ Transmission ☐ Reflection

Input Polarization: Type of Polarization: Linearly Polarized

Angle: 0°

Normalized Jones Vector: $\begin{pmatrix} J_x \\ J_y \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$

Define Parameters for Scan: Angle Defined by: ☒ Cartesian Angle ☐ Spherical Angle

Varied Parameter #1: Pillar Diameter

Varied Parameter #2: Incident Angle Beta

Wavelength: 940 nm

Incident Angle Alpha: 0°

Incident Angle Beta: from 0° to 20°

Pillar Diameter: from 50 nm to 260 nm

Sampling: Number of Steps: 22 x 101; Step Width: 10 nm ; 0.2°

Select Derived Local Quantities to Evaluate: ☐ Output Jones Vector ☐ Amplitude Components ☒ Output Field Square Sum ☐ Phase Components ☒ Local Common Phase ☐ Non-Common Phase Residuals ☐ Common-Phase Residual Variance

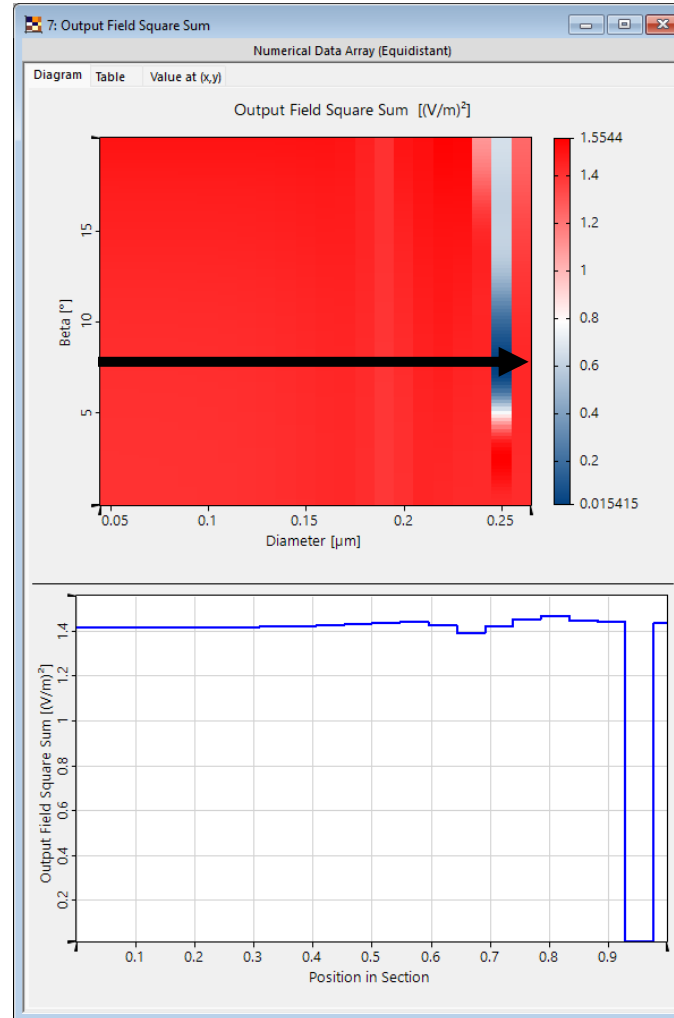
Info:

OK Cancel Help

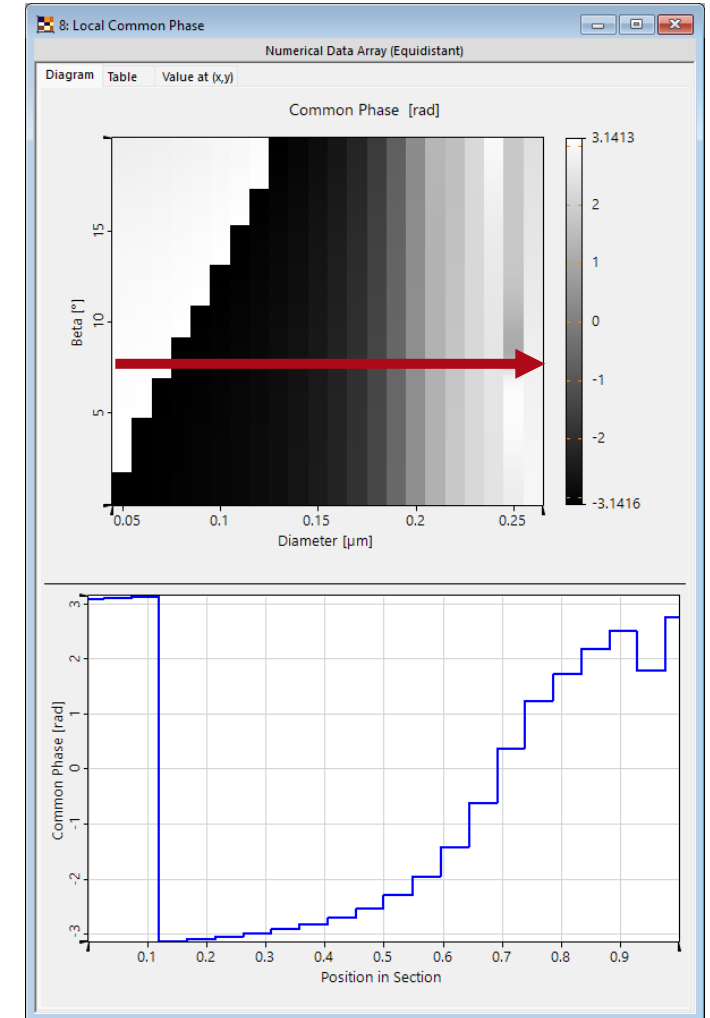
Results

💡 Main Observation

- The Local Common Phase covers for all angles a full 2π phase range, with a slight angle-dependent shift.
- The amplitude response remains close to 1 for most pillar diameters and incidence angles.
- A clear exception occurs at a pillar diameter of 250 nm: near 8° , the resonance strongly degrades the response and absorbs almost all energy.



Field square response

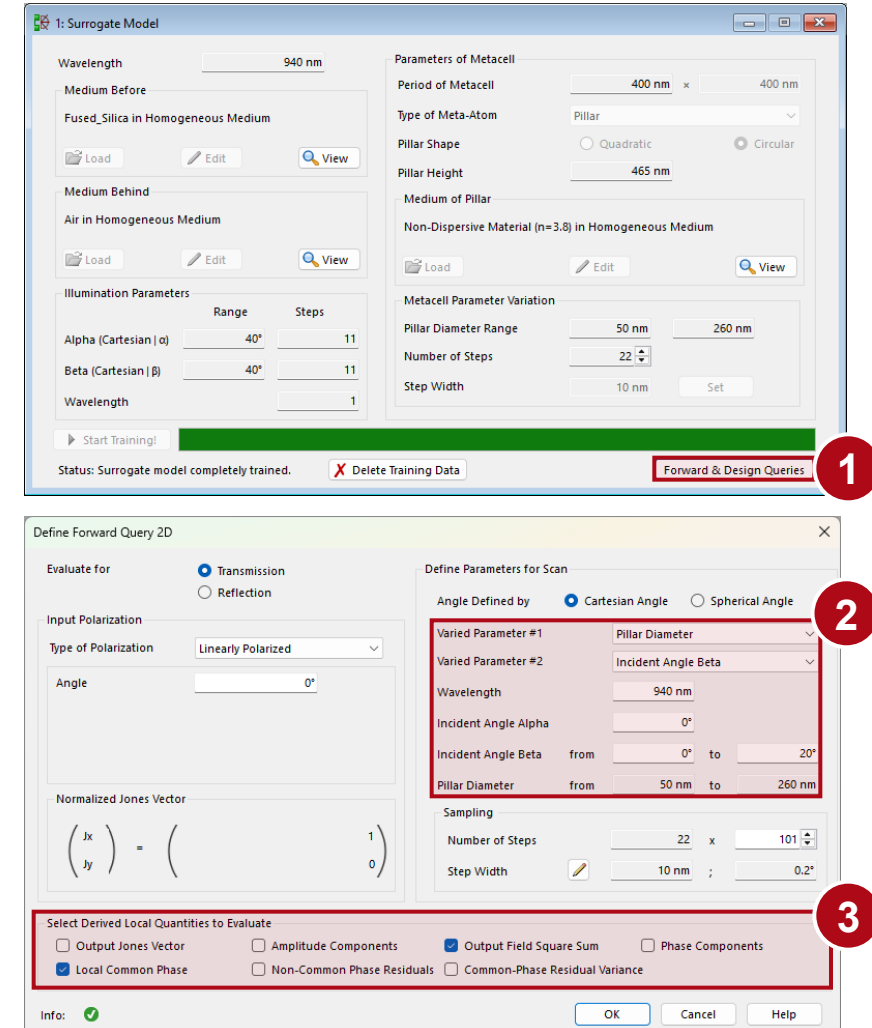


Local common phase

Workflow

1 2 3 What the User Does

1. Open the surrogate model file with the pre-trained nanopillar surrogate model.
2. Click *Forward & Design Queries*. Pick *Forward Query 2D*.
3. Sweep the *Incidence Angle Beta* from 0° to 20° and the *Pillar Diameter* from 50 nm to 260 nm.
4. Select *Output Field Square Sum* and *Local Common Phase* as outputs.
5. Investigate the responses for the given parameter sweep.



Related Documents

White Papers

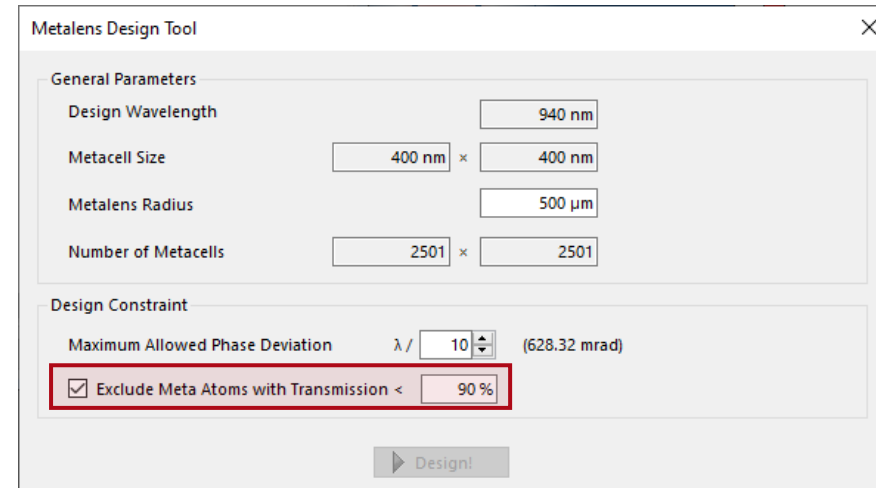
- [WP-META-SURROGATE — Surrogate Modeling: Enabling Practical Metalens Design and Simulation](#)
- [WP-META-PHASE — Designing and Analyzing the Phase Response of Metasurfaces](#)

Use Cases and Feature Demos

- [Surrogate Model Training for Nanopillars](#)
- [Aberration Control via Metalens](#)
- [Transfer Wavefront Phase to a Metalens](#)

→ Suggested Next Steps

- Design a metalens which automatically filters out the pillar diameters where the resonance occurs.
- Compare efficiency between the two cases.



The screenshot shows the 'Metalens Design Tool' window. It has two main sections: 'General Parameters' and 'Design Constraint'. In the 'General Parameters' section, there are input fields for 'Design Wavelength' (940 nm), 'Metacell Size' (400 nm x 400 nm), 'Metalens Radius' (500 μm), and 'Number of Metacells' (2501 x 2501). In the 'Design Constraint' section, there is a 'Maximum Allowed Phase Deviation' set to 10 (628.32 mrad) and a checkbox labeled 'Exclude Meta Atoms with Transmission < 90 %' which is checked. A 'Design!' button is at the bottom right.

The *Metalens Design Tool* has the option to filter out meta-atoms below a transmission threshold.