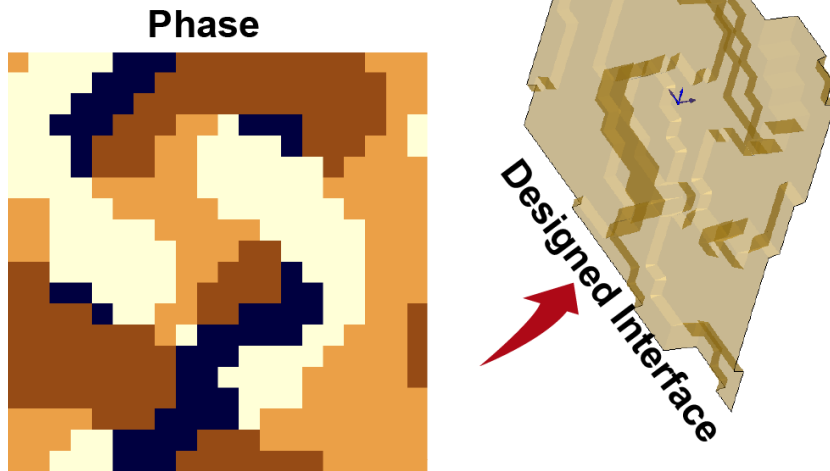


Structure Design

Abstract

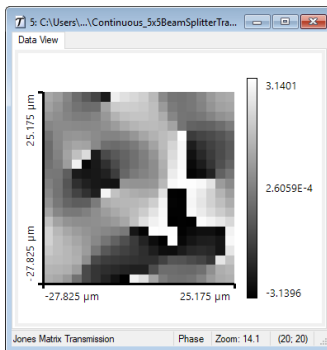


In VirtualLab Fusion the user can design phase functions, which works as beam shaper, beam splitter and diffuser, using the iterative Fourier transformation algorithm. Later these phase function can be converted into a optical structure, which can be a diffractive mirror or a transparent plate. VirtualLab offers a convenient tool to design such an optical structure from a given phase function. This use case shows the usage of the structure design tool.

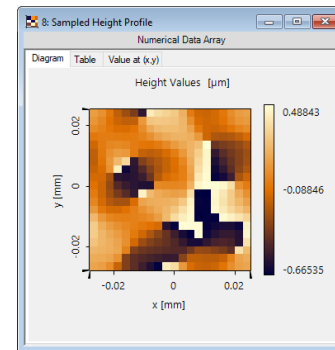
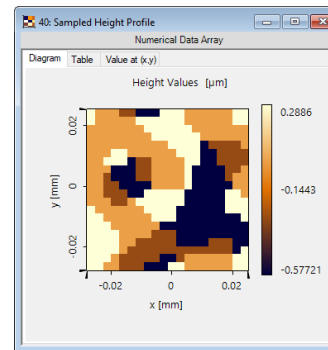
This Use Case Shows...

- how to design an structure (surface height profile) from a phase function

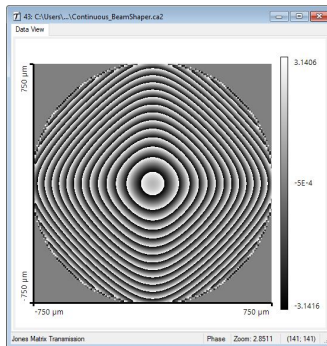
phase with dislocations



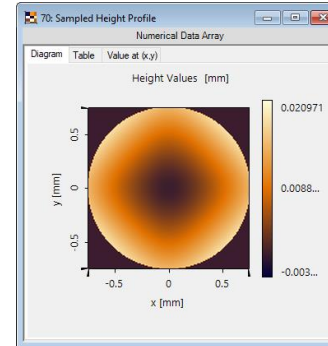
quantized structure smooth structure



phase with 2π -modulo

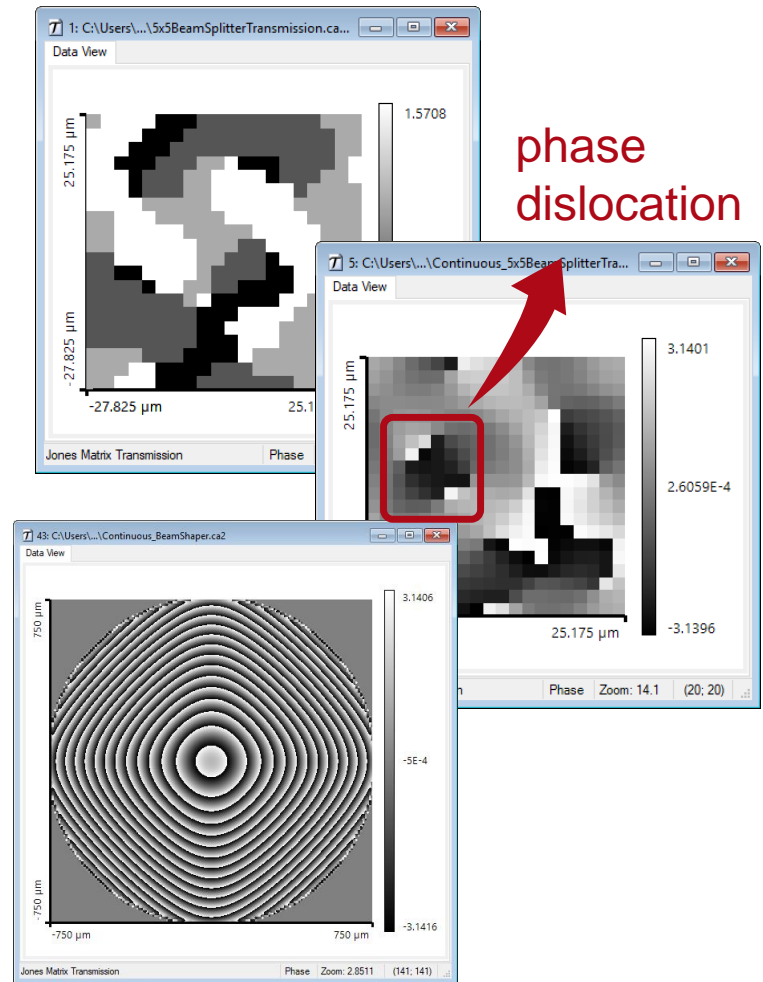


unwrapped structure



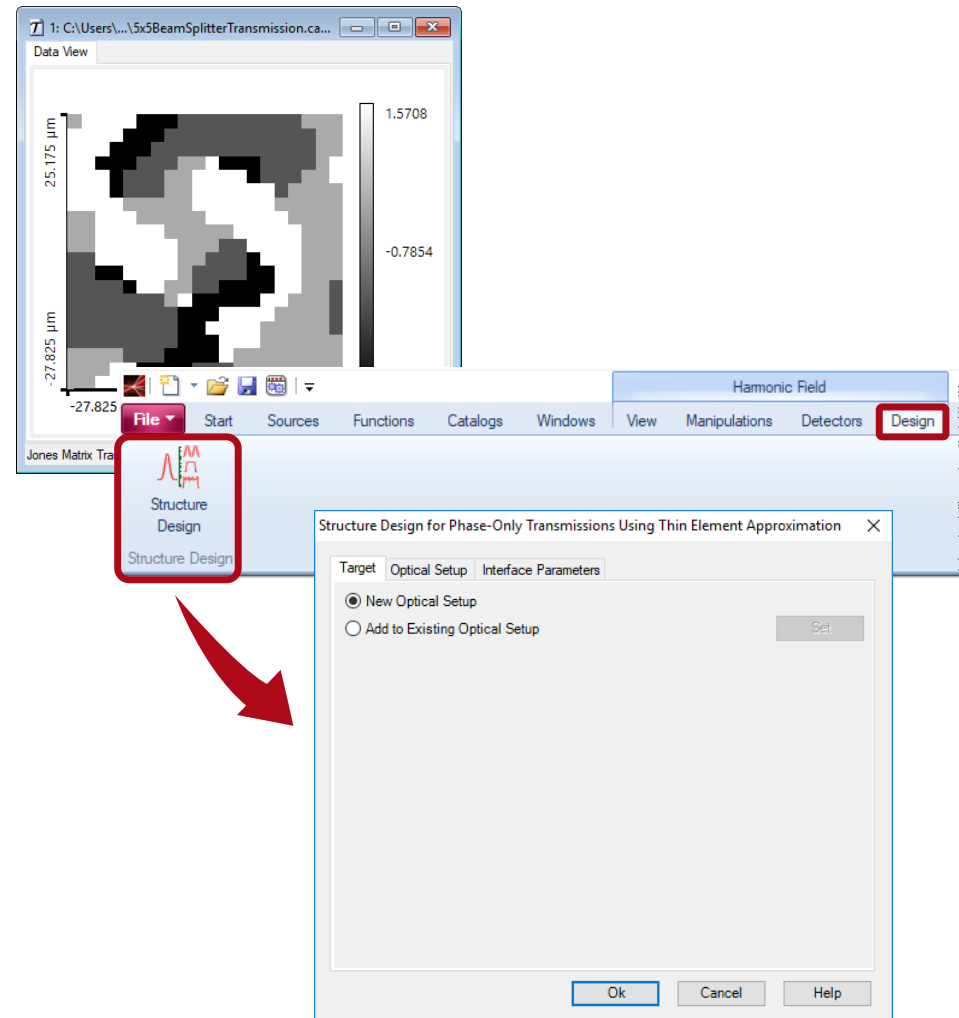
System Construction

- For illustration purpose, we work with
 - phase function with dislocations
 - a quantized one (4-levels)
 - a continuous one
 - a phase function with 2π -modulo



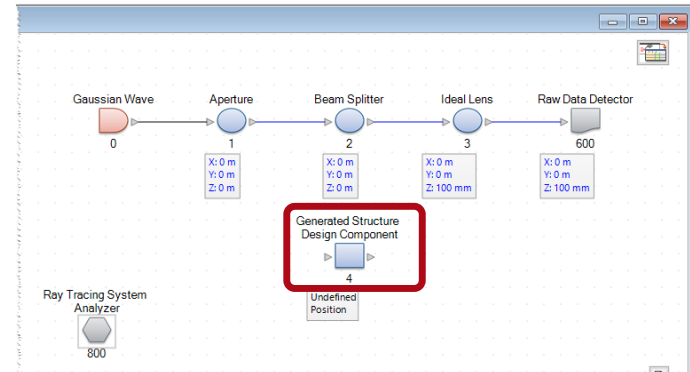
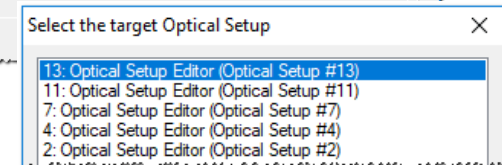
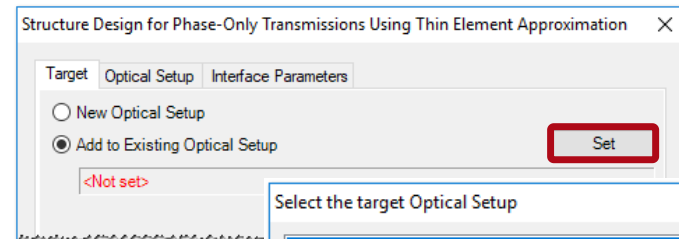
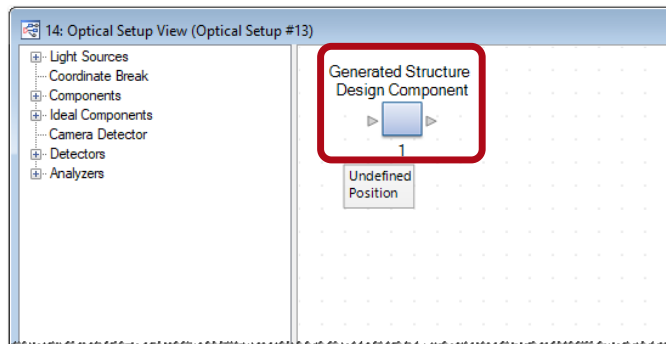
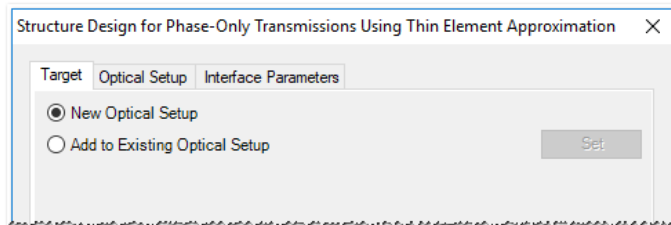
Structure Design: Edit Window

- In the document specific ribbon of transmission function, click *Structure Design*.
- The designed structure is saved in an *Optical Setup*.



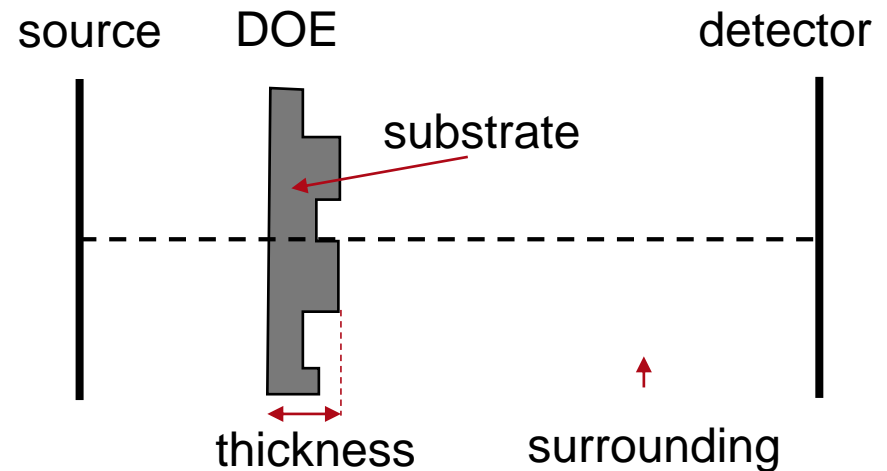
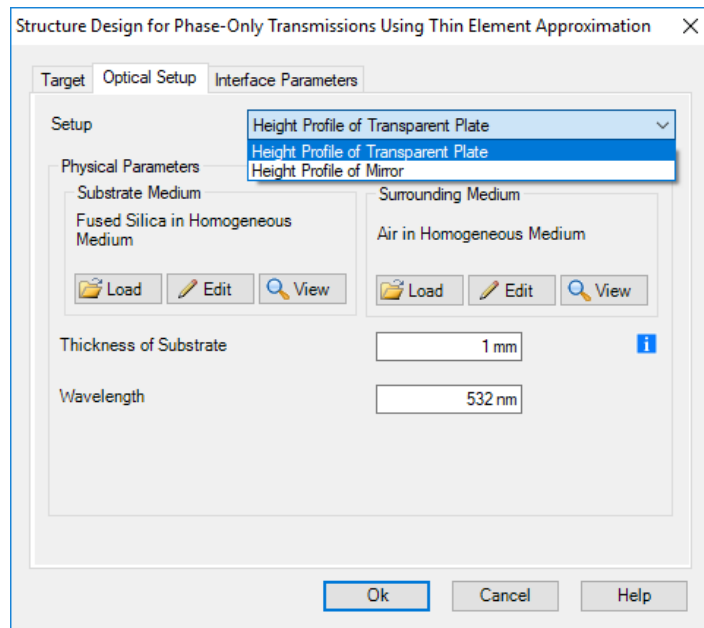
Edit Window: Target

- Choose the *Optical Setup*, in which the designed interface shall be added.



Edit Window: Optical Setup

- Both reflective and transmissive element can be designed.

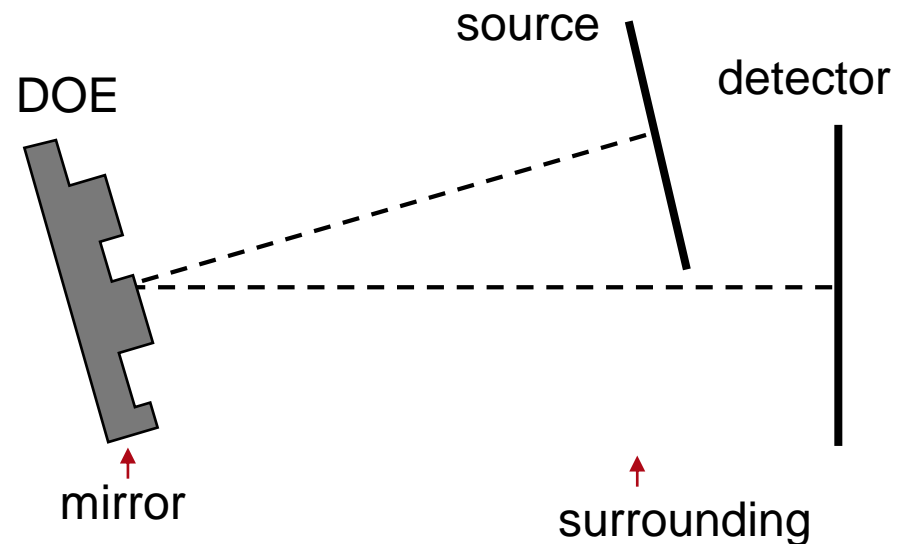
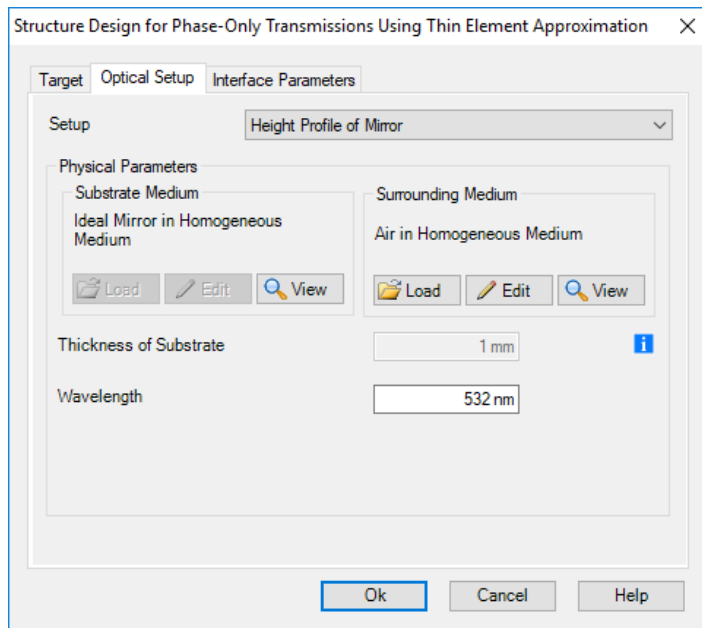


To design transmission DOE, following parameters need to be specified:

- working wavelength
- substrate
- surrounding

Edit Window: Optical Setup

- Both reflective and transmissive element can be designed.

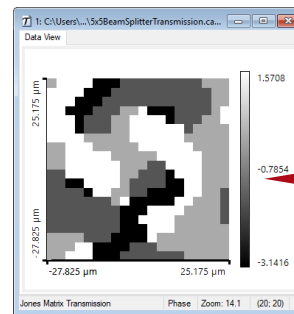
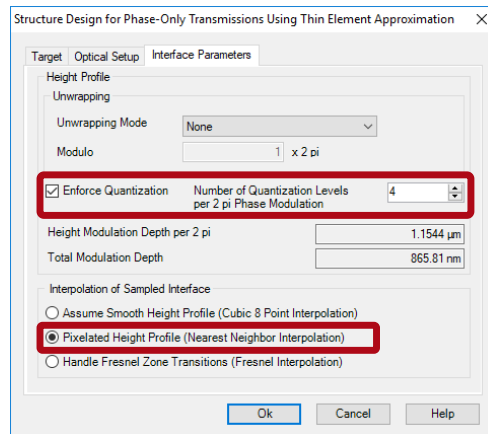


To design reflection DOE, following parameters need to be specified:

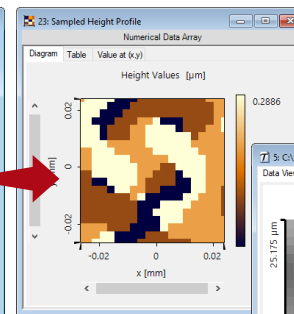
- working wavelength
- surrounding

Quantized Interface from Phase with Dislocations

- Different kinds of interfaces can be generated depending on given phase function and requirements on the surface.
 - phase function with dislocations, both quantized and continuous
 - *Unwrapping Mode* is *None*.
 - If quantized interface is required, *Enforce Quantization* is checked and number of level is given. *Pixelated Height Profile* is ALWAYS checked for quantized structure.

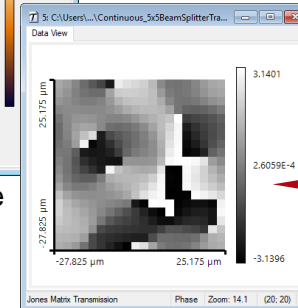


quantized phase

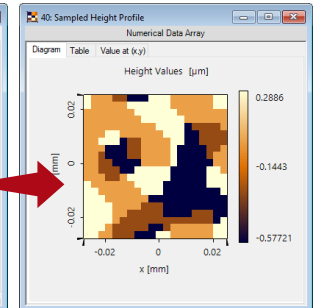


height profile interface

continuous phase



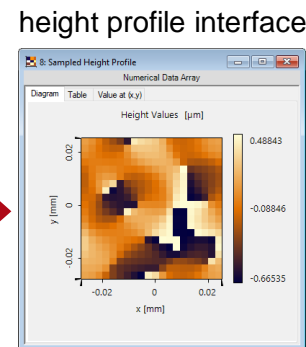
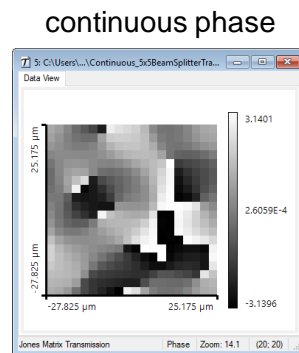
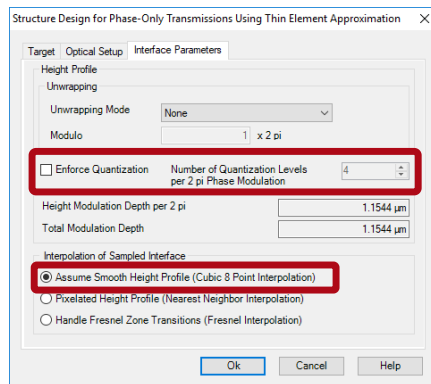
height profile interface



Tips: $\frac{\text{Total Modulation Depth}}{\text{Modulation Depth per } 2\pi} = \frac{N-1}{N}$, with N denoting number of quantization level.

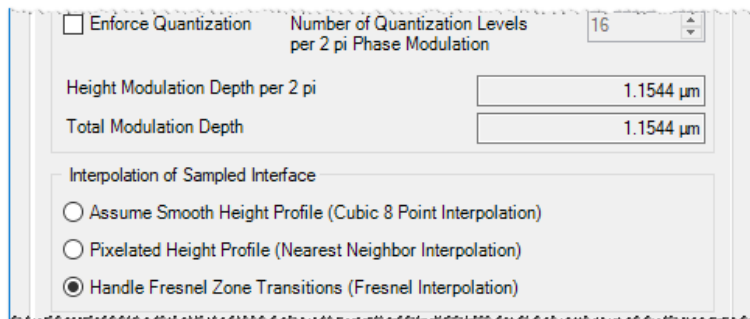
Smooth Interface from Phase with Dislocations

- Different kinds of interfaces can be generated depending on given phase function and requirements on the surface.
 - phase function with dislocations, both quantized and continuous
 - Unwrapping Mode is None.
 - If quantized interface is required, Enforce Quantization is checked and number of level is given. Pixelated Height Profile is ALWAYS checked for quantized structure.
 - If continuous interface is designed, *Assume Smooth Height Profile* is ALWAYS checked

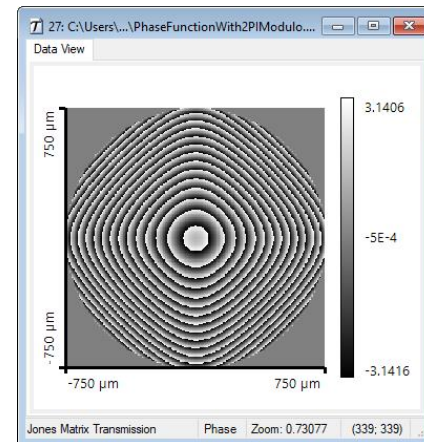


Interface from a Wrapped Phase

- This phase function contains jumps to 2π steps (2π -modulo). Depend on the requirement of structure, different *Unwrapping Modes* can be used.
 - *None*: no unwrapping.
 - *Partial*: unwrap the phase into 2π -, 4π -, ... $N \cdot 2\pi$ -modulo.



Interpolation **Handle Fresnel Zone Transitions** is recommended. This is a special interpolation which avoids interpolation artifacts at the Fresnel jumps.

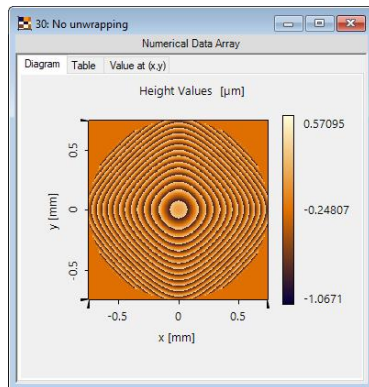


Phase with 2π -modulo

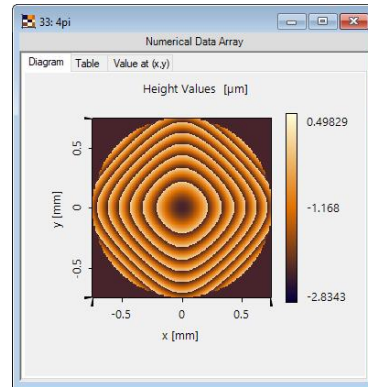
Wrapped and Partially Unwrapped Interface

- This phase function contains jumps to 2π steps (2π -modulo). Depend on the requirement of structure, different *Unwrapping Modes* can be used.
 - *None*: no unwrapping.
 - *Partial*: unwrap the phase into 2π -, 4π -, ... $N \cdot 2\pi$ -modulo.

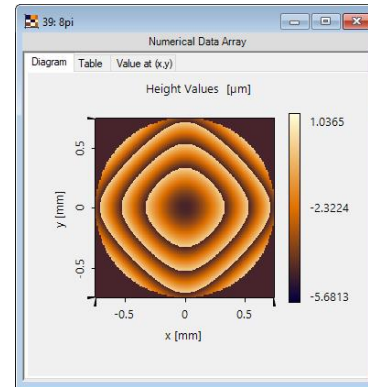
designed interface



no unwrapping



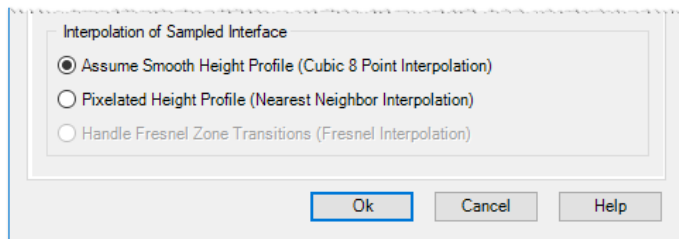
partially: 4π



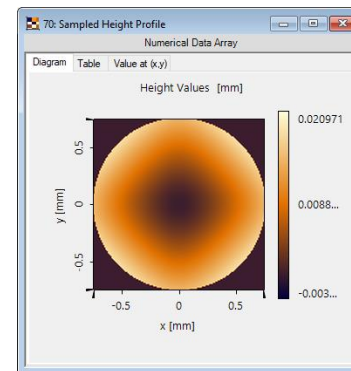
partially: 8π

Fully Unwrapped Interface

- This phase function contains jumps to 2π steps (2π -modulo). Depend on the requirement of structure, different *Unwrapping Modes* can be used.
 - None: no unwrapping.
 - Partially: unwrap the phase into 2π -, 4π -, ... $N \cdot 2\pi$ -modulo.
 - *Full*: completely unwrap



Interpolation *Assume Smooth Height Profile* is recommended.



designed interface: Full

Document Information

| | |
|---------------------------------|------------------|
| title | Structure Design |
| version | 1.0 |
| VL version used for simulations | 7.3.0.50 |
| category | Feature Use Case |
