WYROWSKI PHOTONICS

Feature.0013

Parametric Optimization of a Half-symmetric Two-mirror Resonator

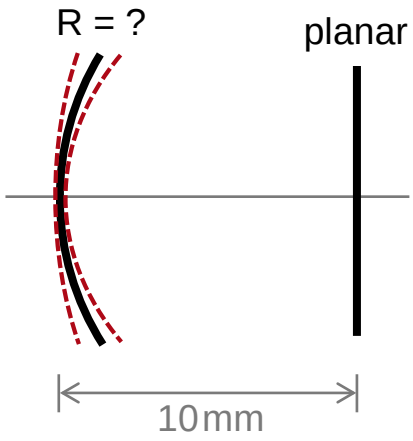
Construction of a two-mirror laser resonator in a half-symmetric configuration, and use of parametric optimization to find the mirror curvature for a desired output bean size

About This Use Case

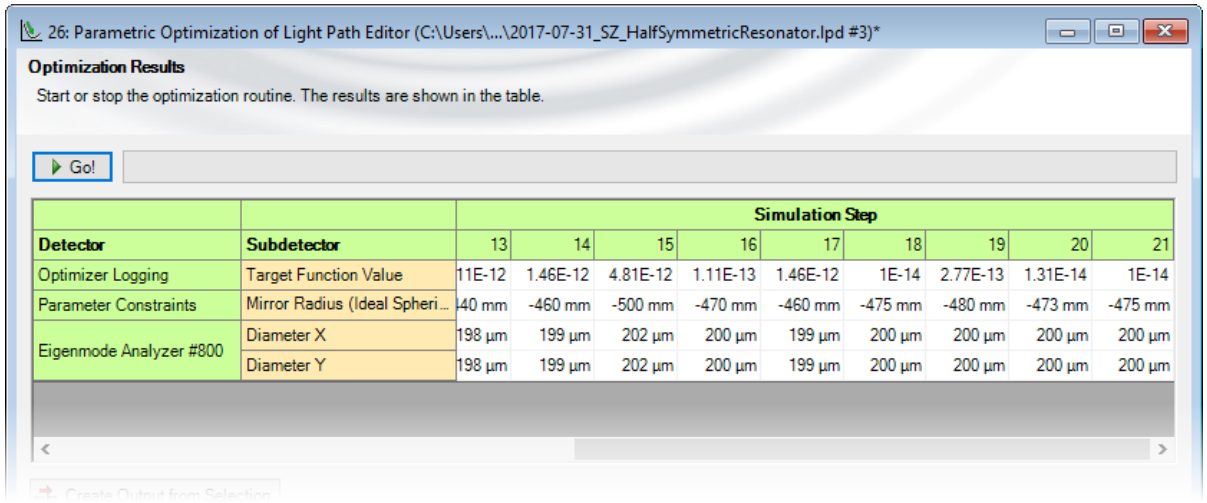
- The following toolbox is required
  - Laser Resonator toolbox
- This use case is produced with VirtualLab Fusion (Build 7.0.0.35).
- Get your free Trial Version here!

This Use Case Shows ...

- how to use parametric optimization for the design / optimization of a laser resonator.



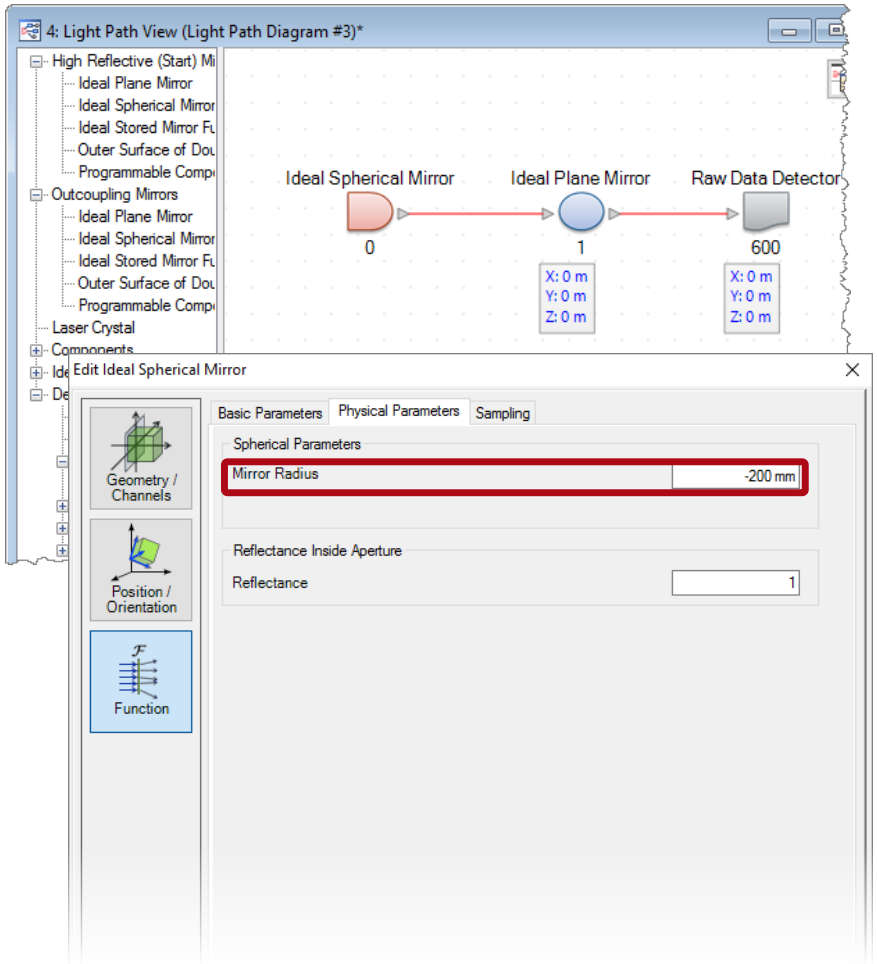
desired laser beam diameter: 200 µm



		Simulation Step								
Detector	**Subdetector**	13	14	15	16	17	18	19	20	21
Optimizer Logging	Target Function Value	11E-12	1.46E-12	4.81E-12	1.11E-13	1.46E-12	1E-14	2.77E-13	1.31E-14	1E-14
Parameter Constraints	Mirror Radius (Ideal Spheri...	40 mm	-460 mm	-500 mm	-470 mm	-460 mm	-475 mm	-480 mm	-473 mm	-475 mm
Eigenmode Analyzer #800	Diameter X	198 µm	199 µm	202 µm	200 µm	199 µm	200 µm	200 µm	200 µm	200 µm
	Diameter Y	198 µm	199 µm	202 µm	200 µm	199 µm	200 µm	200 µm	200 µm	200 µm

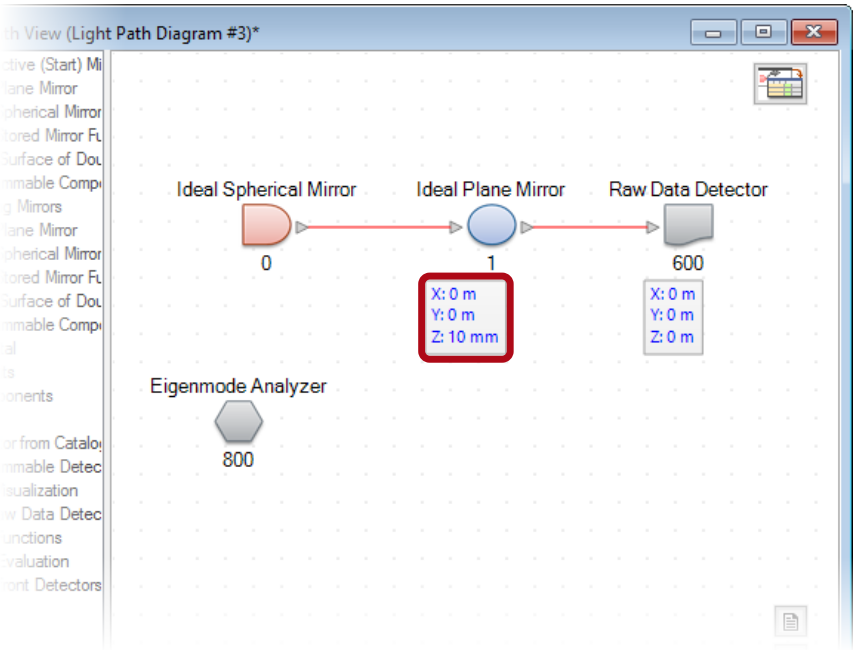
Initial Resonator Construction

- Construction
  - In the laser resonator toolbox, we build up a half-symmetric resonator, with one spherical and one planar mirror.
  - Set the *Mirror Radius* of the ideal spherical mirror to -200 mm.



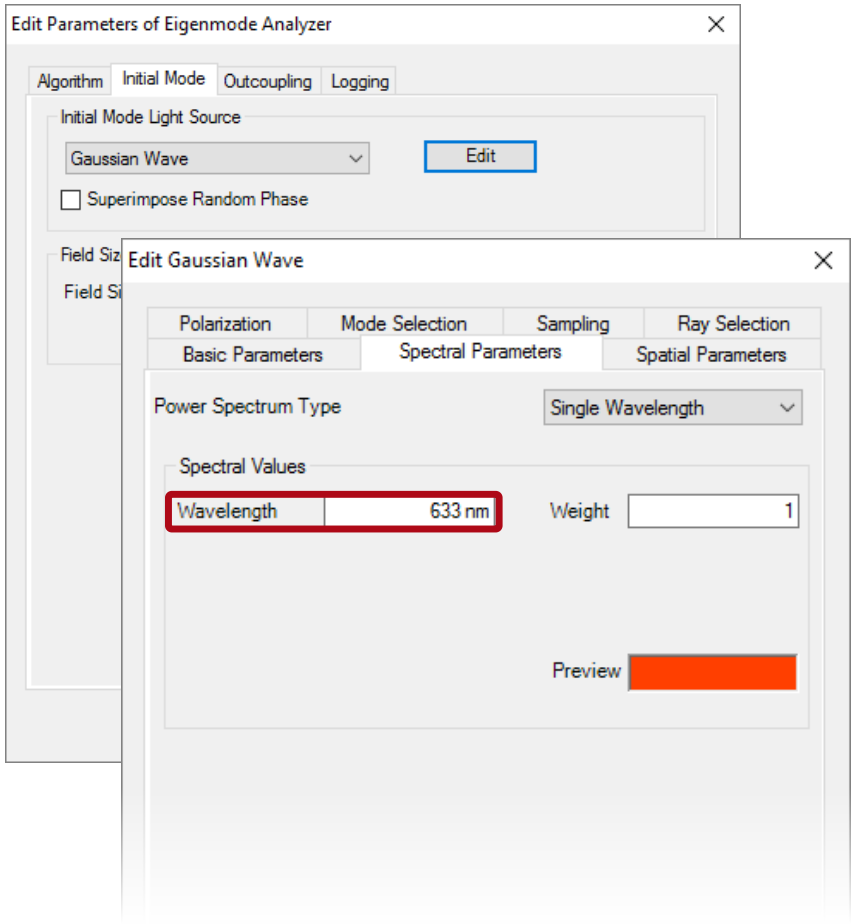
Initial Resonator Construction

- Construction
  - In the laser resonator toolbox, we build up a half-symmetric resonator, with one spherical and one planar mirror.
  - Set the Mirror Radius of the ideal spherical mirror to -200 mm.
  - Set the distance between mirrors i.e. resonator length to 10 mm.



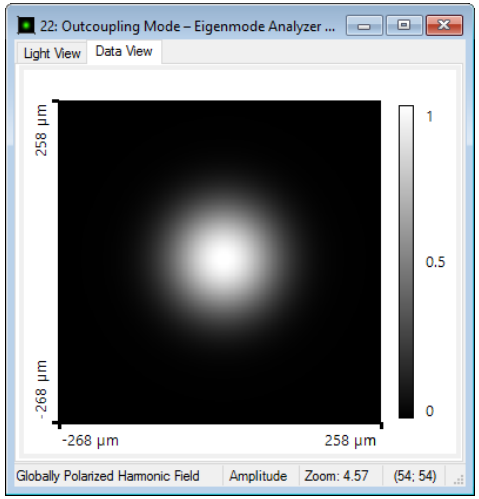
Initial Resonator Analysis

- Eigenmode analyzer
  - Set up the eigenmode analyzer, set the Wavelength equal to 633 nm for the Initial Mode.
  - Keep other settings like iteration number and threshold as default in this example.



Initial Resonator Analysis

- Eigenmode analyzer
  - Run the simulation, and we obtain the converged mode calculated after a few iterations.
  - The mode has a beam diameter of 176 µm.



calculated eigenmode amplitude after interpolation

19: Eigen Mode Analysis*

Go!

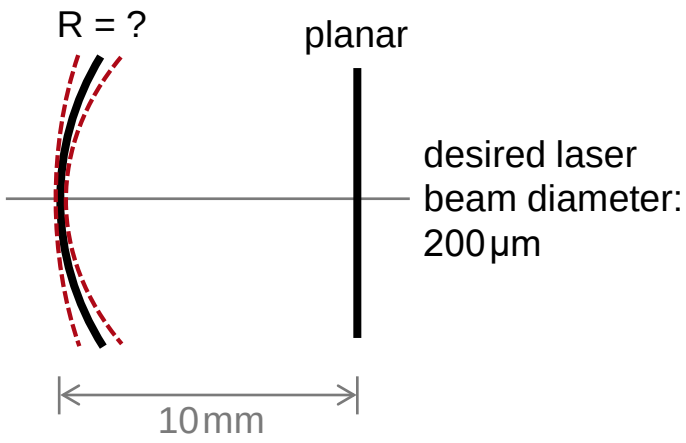
			Iteration Step			
Detector	**Subdetector**	**Combined Output**	2	3	4	5
Eigenmode Analyzer	Eigenvalue, 1st	Data Array	1	1	1	1
	Eigenvalue, 2nd	Data Array	33	0.991	0.991	0.999
	Deviation, absolute (rescal...	Data Array	10	1.87E-12	2.49E-14	8.67E-15
	Deviation, relative (rescale...	Data Array	25	0.000147	2E-06	6.97E-07
	Diameter X	Data Array	m	176 µm	176 µm	176 µm
	Diameter Y	Data Array	m	176 µm	176 µm	176 µm
	Losses	Data Array	%	0 %	0 %	0 %
Reference Eigenmode		Animation	ld	Harmonic Field	Harmonic Field	Harmonic Field

Create Output from Selection

In this example, the number of displayed digits (global settings) is set to 3. With a different setting, the displayed results may look different.

Laser Resonator Design / Optimization

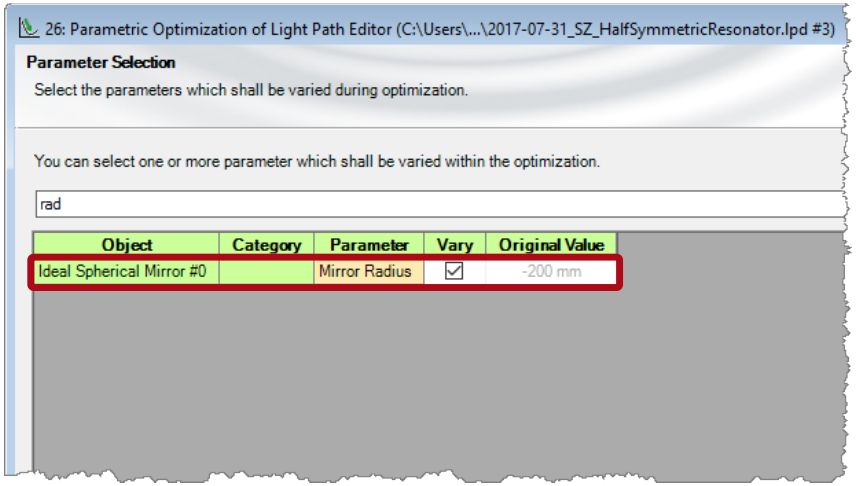
- Beam size optimization
  - It is often required to obtain a desired beam size for certain applications.
  - In this example, we expect a diameter of 200 µm from the output mode.



- Parametric optimization
  - For such a task, we take use of the parametric optimization, in which the mirror radius will be varied so to find the proper value that delivers the expected beam diameter.

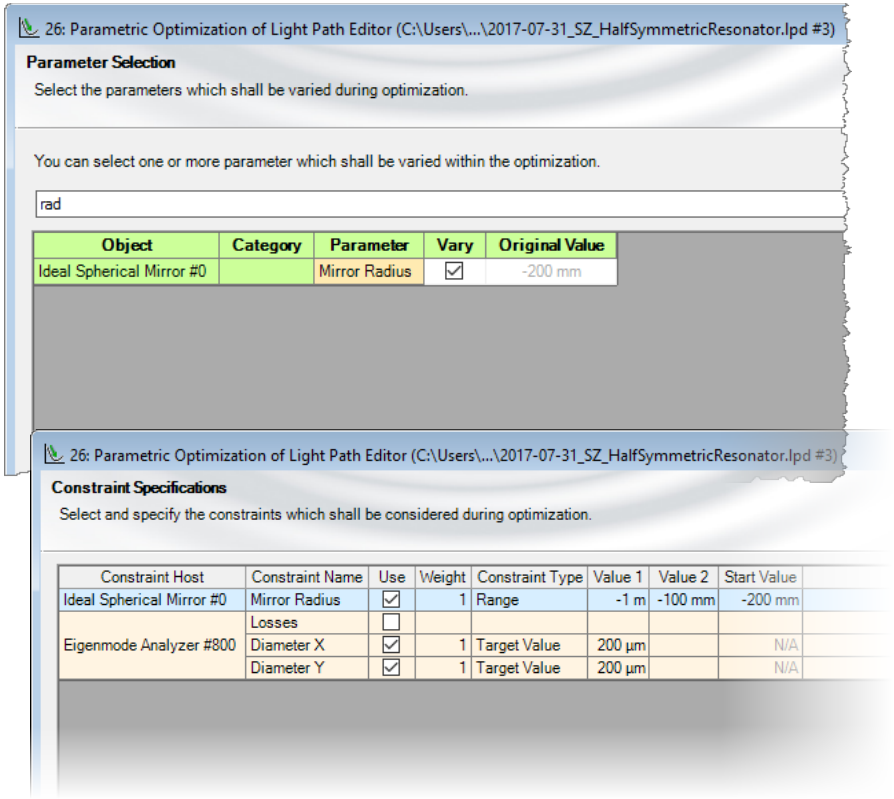
Laser Resonator Design / Optimization

- Optimization settings
  - Check *Mirror Radius* of the spherical mirror as the variable (type in keywords to locate the parameter quickly).



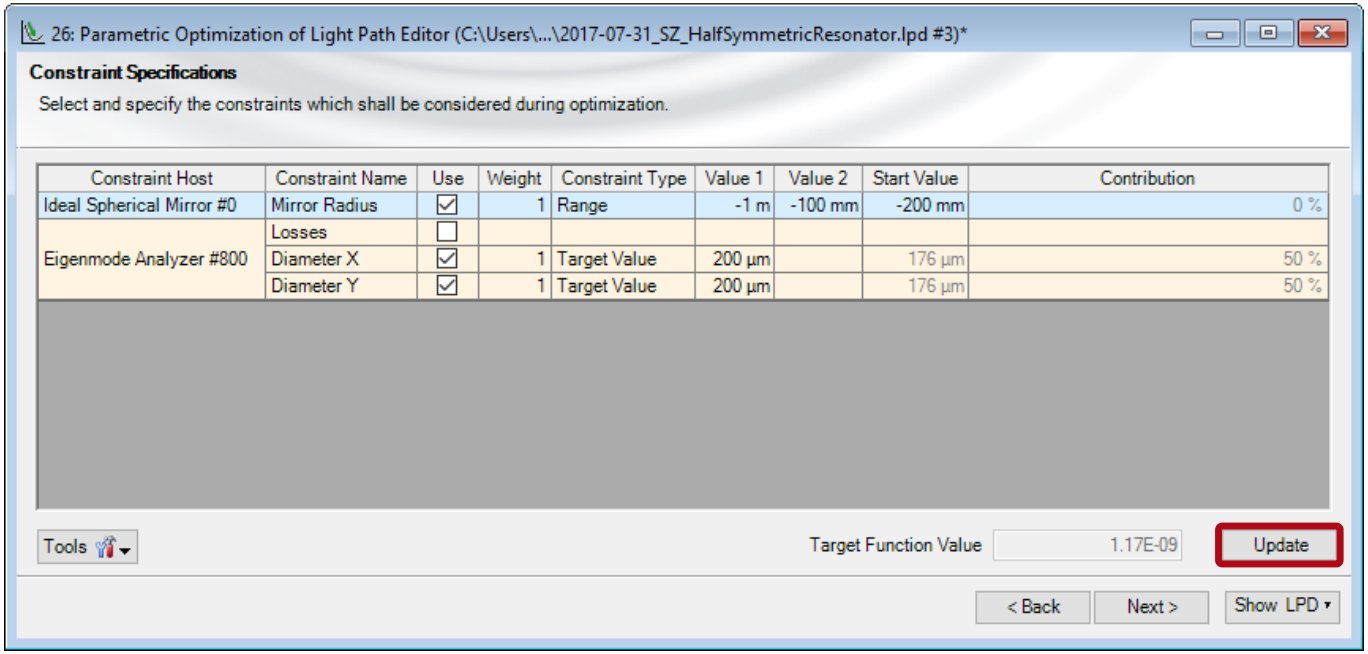
Laser Resonator Design / Optimization

- Optimization settings
  - Check Mirror Radius of the spherical mirror as the variable (type in keywords to locate the parameter quickly).
  - Set the constraints for the optimization: *Mirror Radius* in the range between -1 m and -100 mm; *Diameter X/Y* should reach the target value of 200 µm.



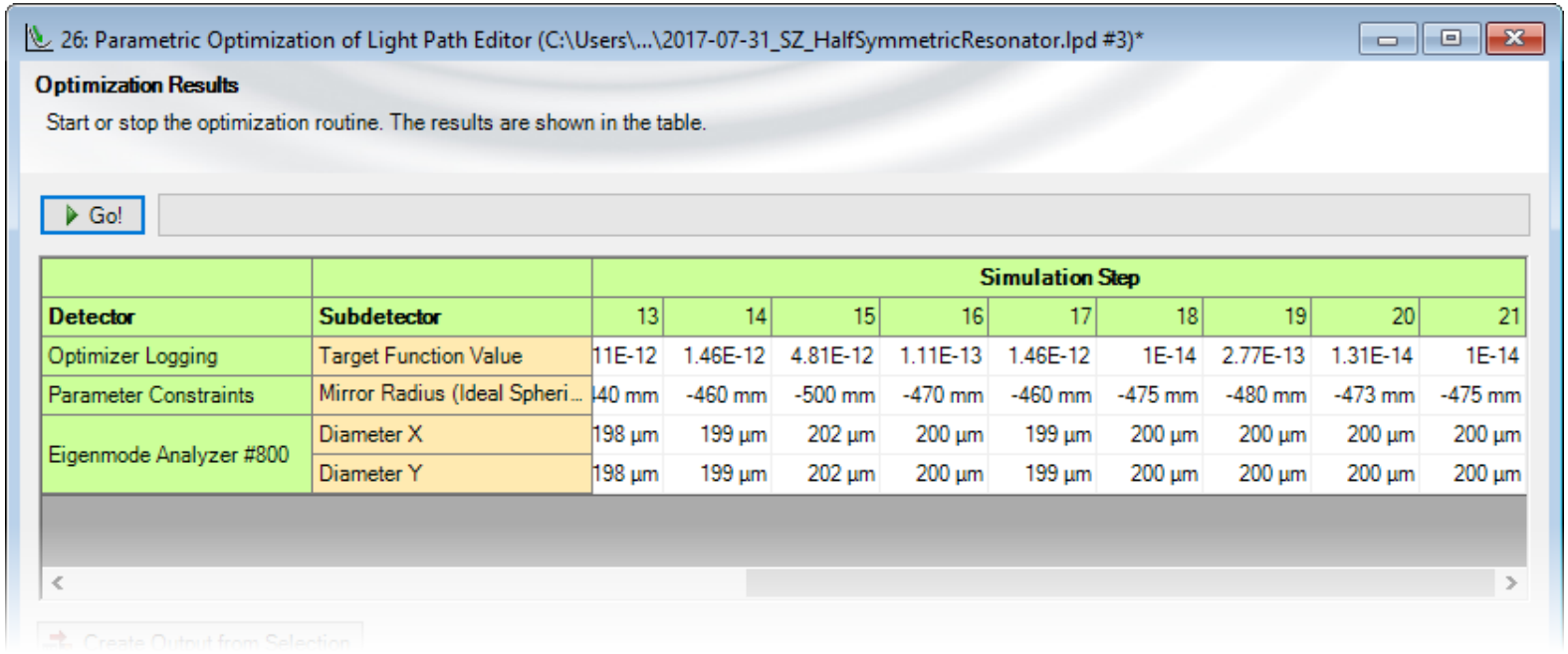
Laser Resonator Design / Optimization

- Optimization settings
  - Click on *Update* button, and have an overview on the optimization: e.g., to check the contribution of each constraint according to their weight.



Laser Resonator Design / Optimization

- Optimization result
  - After a few iterations, the mirror radius is found to be -475mm, so the resonator delivers an output beam with the diameter of 200µm.



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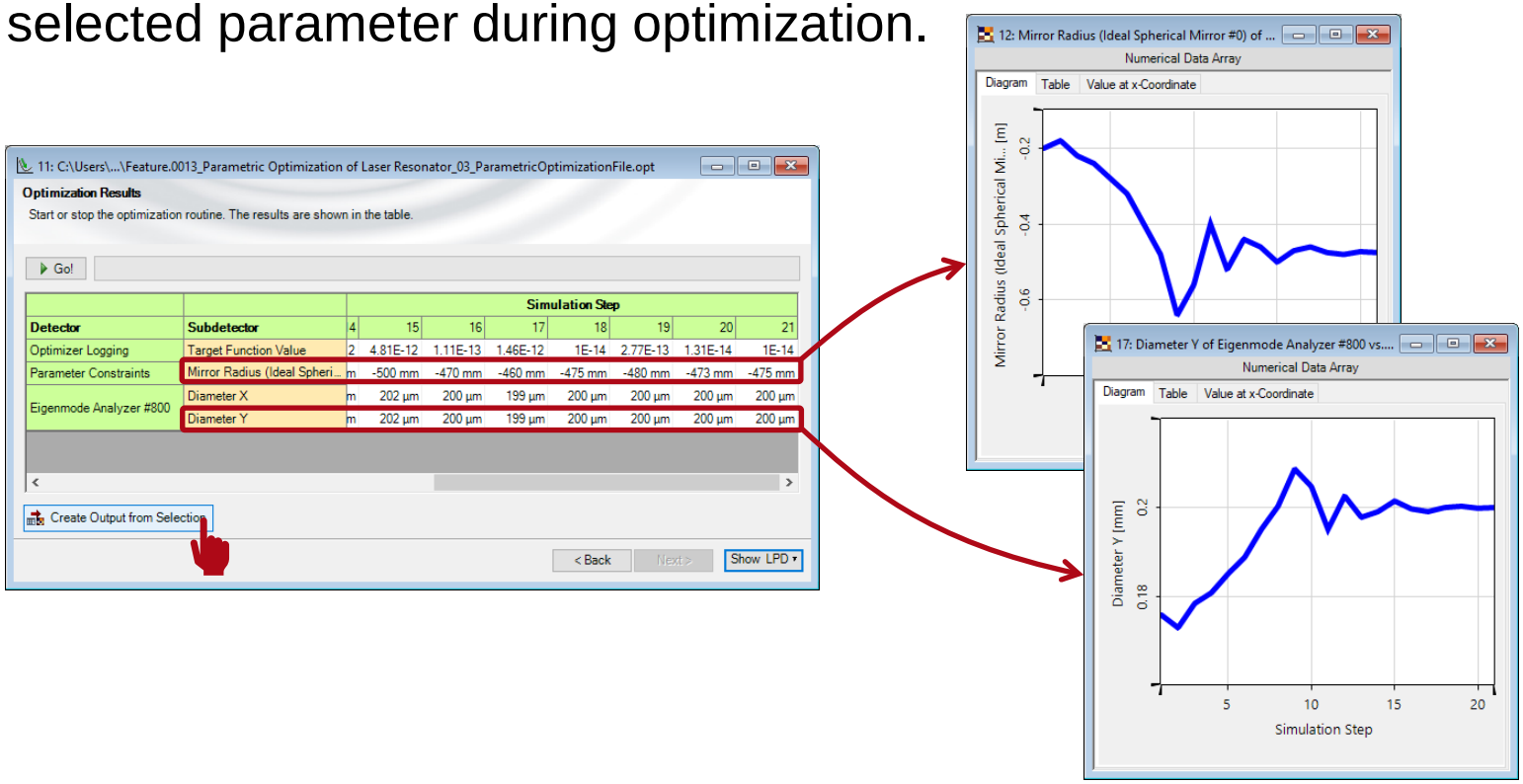
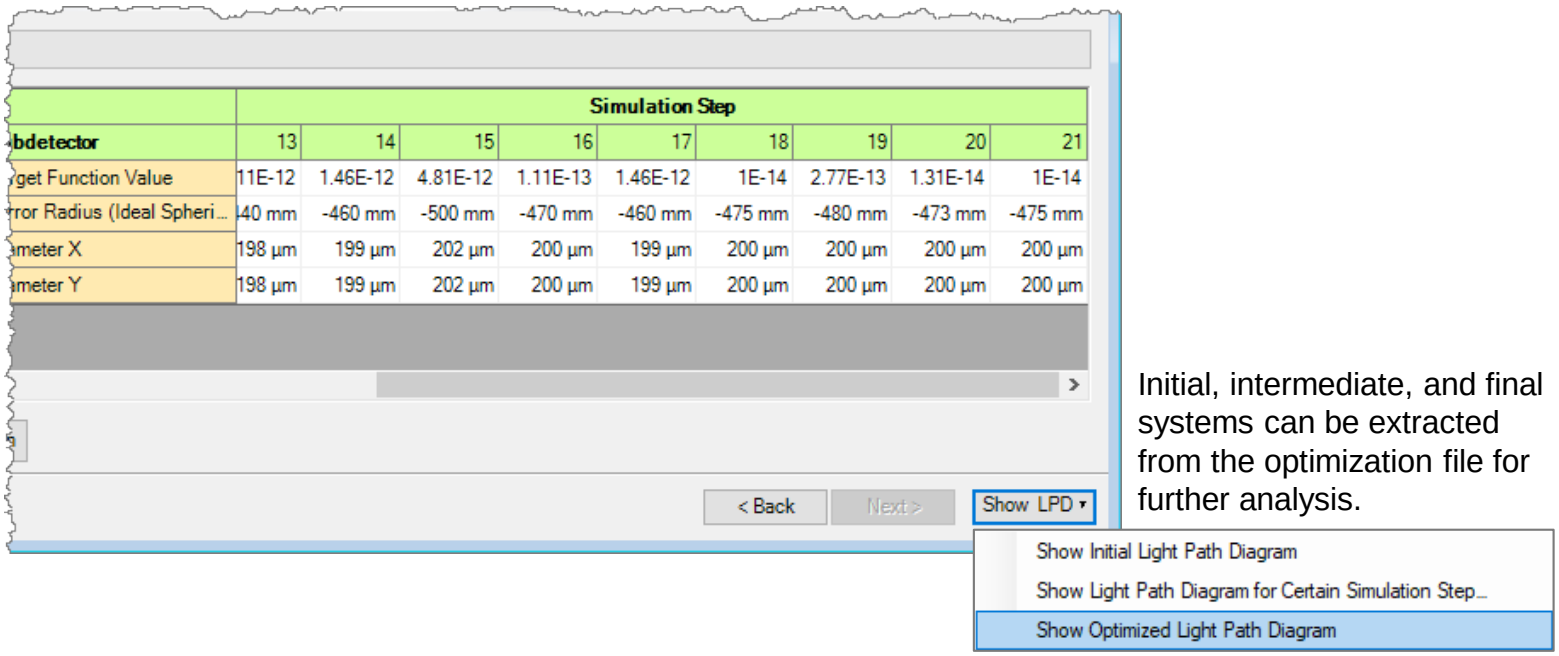
Laser Resonator Design / Optimization

- Optimization result
  - By selecting a certain row of data, and clicking on the icon Create Output from Selection, one can examine the convergence of a selected parameter during optimization.



Laser Resonator Design / Optimization

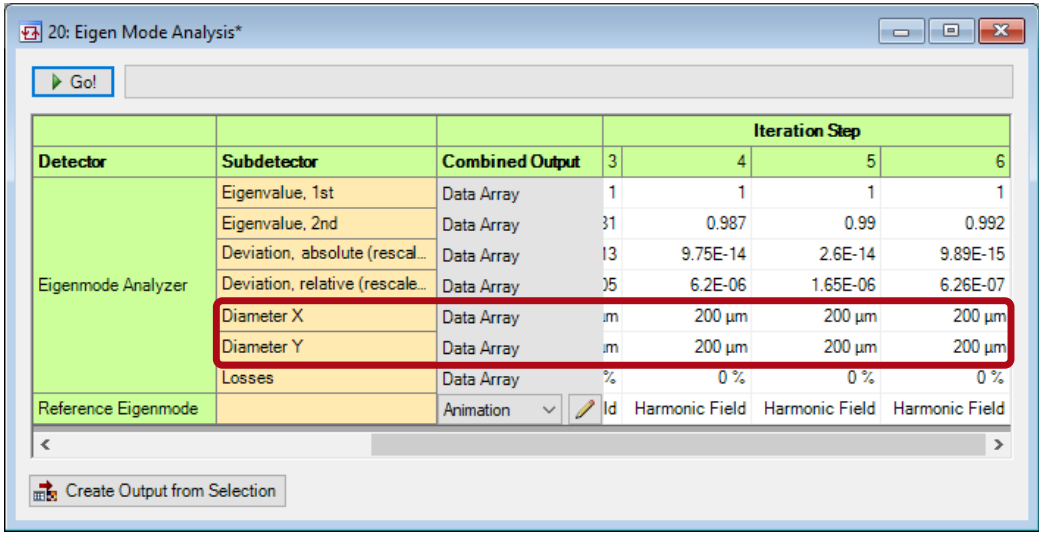
- Optimization result
  - Finally, we extract the LPD containing the optimized laser resonator from the optimization.

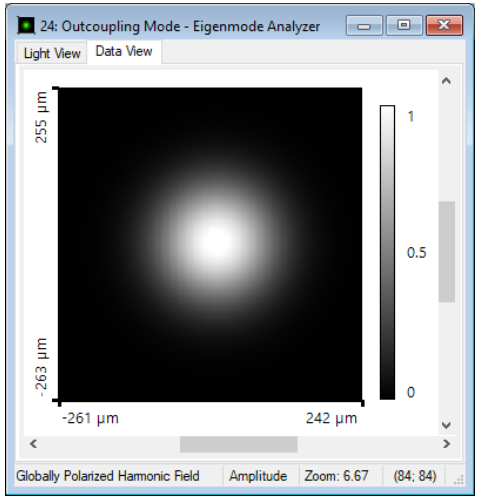


Initial, intermediate, and final systems can be extracted from the optimization file for further analysis.

Optimized Resonator Analysis

- Eigenmode analyzer
  - Similarly as before, we perform eigenmode analysis for the optimized resonator.
  - After a few iterations, the mode of the optimized resonator is calculated with a beam diameter of 200 µm, as desired.





calculated eigenmode amplitude after interpolation

Document & Technical Info

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