

# INTERFACE DOCUMENTATION SHEET

Engineering Project No. 05  
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*ODAI : Optical Devices Made with AI*

Optical design and AI: the case of wide-field eyepieces designed using  
unsupervised learning



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## **Version history**

Version	Date	Autor	Added value
1.0	08/04/2024	Aurélien	Document creation

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# **Introduction**

## **General presentation :**

This interface uses the parameters of the initial system, the optimisation parameters and the environment to optimise the system for a chosen number of lenses.

## **Target audience :**

Requires a basic knowledge of optics and a minimum knowledge of CodeV software.

## **System requirements:**

- CodeV
- Python ( and “pip install numpy matplotlib networkx pywin32 tk” )

# I - Detailed explanation of sub-windows and functions

The screenshot displays the 'Optical System Configuration Interface' window. It features a tabbed interface with 'Environment', 'SP Parameters', 'Tree', 'Starting System', 'Console Output', and 'Output'. The 'Environment' tab is active, showing 'Environment Settings'. This section includes a '+ Add Wavelength' button, a list of five wavelength input fields (486.1327, 546.074, 587.5618, 632.2, 657.2722) each with a '-' button, a '+ Add Field' button, a list of three field input fields (0, 0, 0) each with a comma, a number (3, 6, 35), and a '-' button, an 'EFL' label, an input field with '1', a 'fd' label, and an input field with '5'. At the bottom, there is a 'Submit' button and a 'HELP' button.

**Wavelength:** Sets the wavelengths for which the optical system should be optimised, to target superior performance on the light frequencies essential to your specific application

**Field:** Specifies field positions to test optical quality at different points in the field of view, from centre to periphery, to ensure a sharp image across the entire field of view

**EFL** (effective focal length): Specifies the desired effective focal length for the system, a key parameter that influences the system's ability to focus light

**fd:** Sets the f/d ratio to define the aperture of the system, influencing both the amount of light captured and the depth of field of the optics

Optical System Configuration Interface

Environment SP Parameters Tree Starting System Console Output Output

SP Parameters

Epsilon  
0.5

+ Add Lens Thickness Step

0.05 -

0.1 -

0.15 -

0.4 -

Air Distance Steps  
0

Lens Thickness  
0.4

Base Material  
NBK7\_SCHOTT

Submit

HELP

**Epsilon:** Determines the precision of the convergence of the optimization, which influences the tolerance for stopping the iteration when the solution approaches the saddle point sufficiently

**Lens Thickness Step:** Establishes the increments in which the lens thickness will be adjusted during optimisation with the last value determining the final lens thickness

**Air Distance Step:** Defines the distance between two lenses during the optimisation phase

**Lens thickness:** Enter an initial value in which must correspond to the final value specified in 'Lens Thickness Step', thus establishing the target thickness for the lens after optimisation

**Base material:** Determines the lens material used during saddle point optimization

The screenshot shows a software window titled "Optical System Configuration Interface". It has a menu bar with "Environment", "SP Parameters", "Tree", "Starting System", "Console Output", and "Output". The "Tree" tab is selected, showing a large empty area labeled "Tree". To the right of this area are three input fields: "Starting Depth:" with the value "0", "Target Depth:" with the value "1", and "Base File Path:" with the value "C:/CVUSER". At the bottom center is a "Submit" button, and at the bottom right is a "HELP" button.

**Starting Depth:** Specifies the basic complexity of the optical system at which optimisation will begin: '0' for a single lens, '1' for a doublet, '2' for a triplet, indicating the number of pre-existing lenses to be refined

**Target Depth:** Determines the desired final complexity of the optical system after optimisation: '0' to develop a doublet, '1' for a triplet, '2' for a quadruplet, thus increasing the number of lenses in the target design

**Base File Path:** Specifies the file system location where optical system master data and optimisation results will be saved and retrieved

The screenshot shows a software window titled "Optical System Configuration Interface". It has a tabbed interface with tabs for "Environment", "SP Parameters", "Tree", "Starting System", "Console Output", and "Output". The "Starting System" tab is active, displaying "Starting System Parameters".

Parameters shown:

- Surface 1 Radius: 59.33336
- Surface 2 Radius: -391.44174
- Base Material: NBK7\_SCHOTT
- Surface 1 Lens Thickness: 0.2
- Surface 2 Lens Thickness: 97.703035

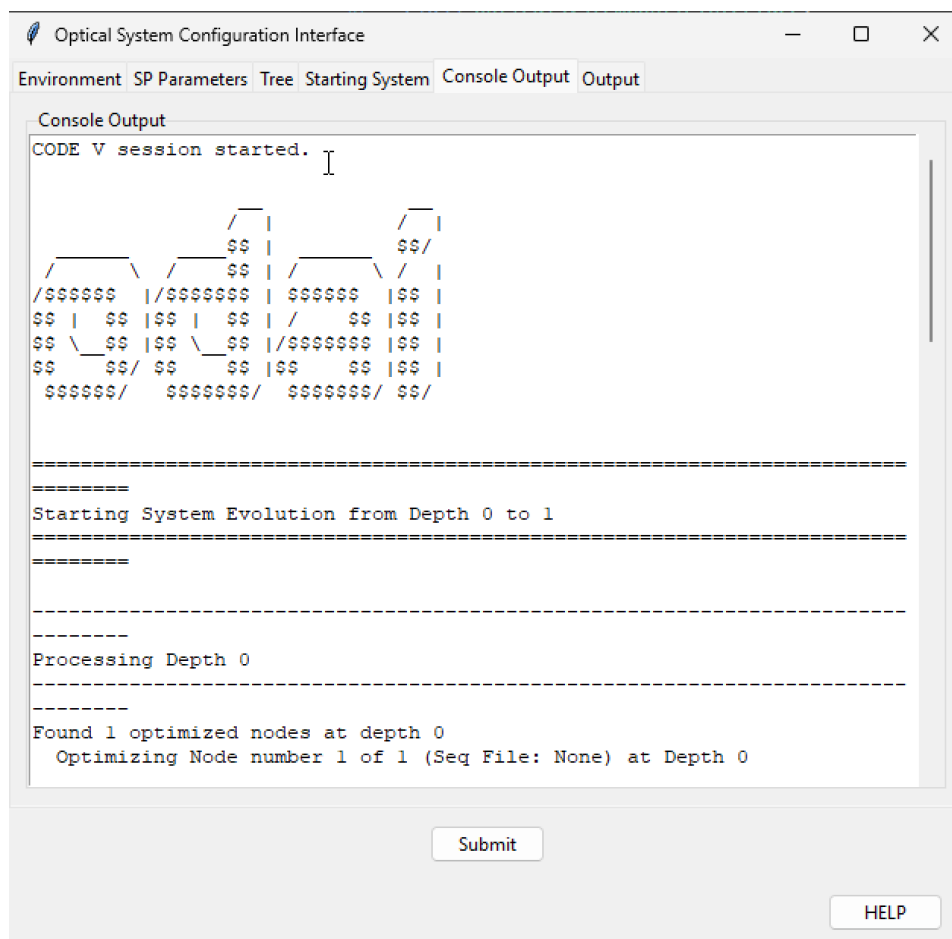
Buttons at the bottom: "Submit" and "HELP".

**Surface 1 Radius & Surface 2 Radius:** Defines the radius of the first and second surfaces of your starting lens to determine the curvature of each face

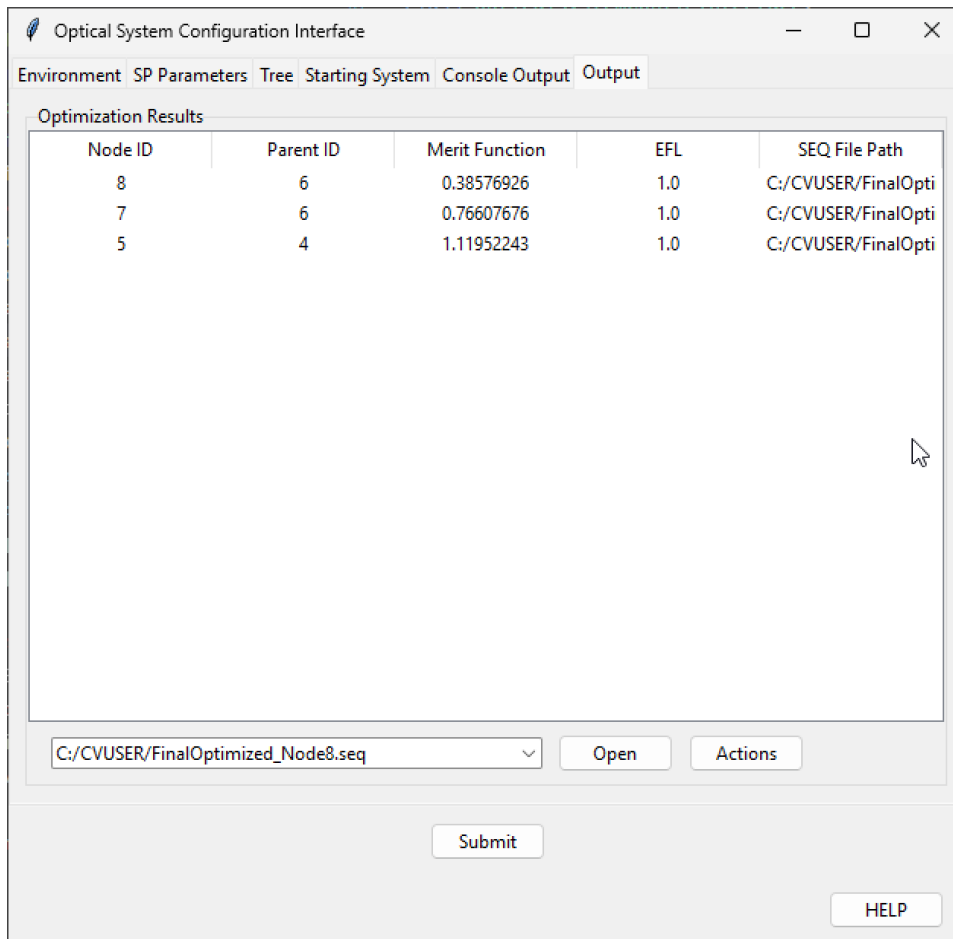
**Lens thickness:** Defines the initial thickness for the lens

**Base material:** Selects the base material for the lens, which will be applied evenly to both surfaces of the starting lens

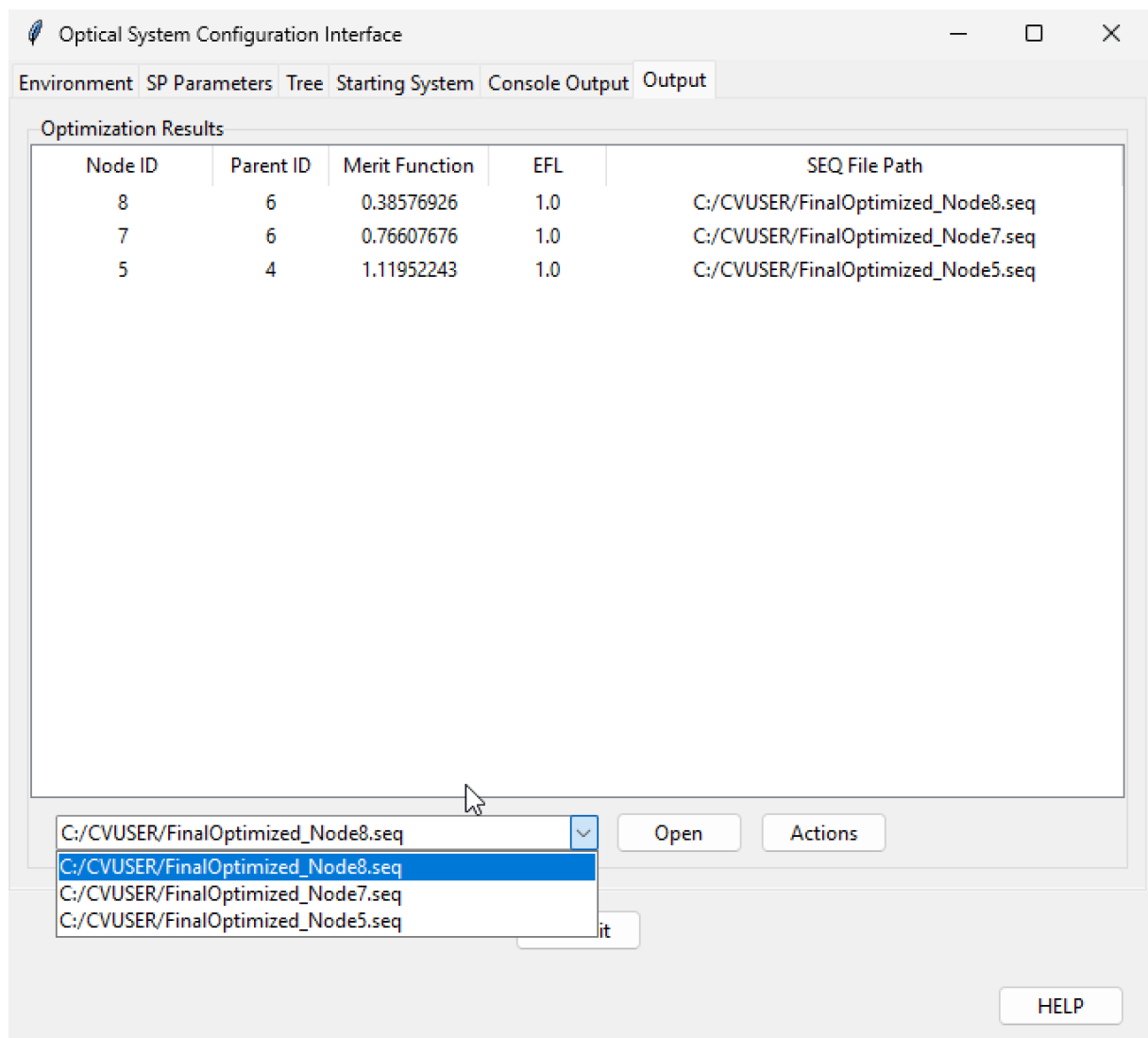




**Consol Output:** Provides a real-time summary of optimisation status, enabling users to track progress and understand where they are in the evolution of the optical system



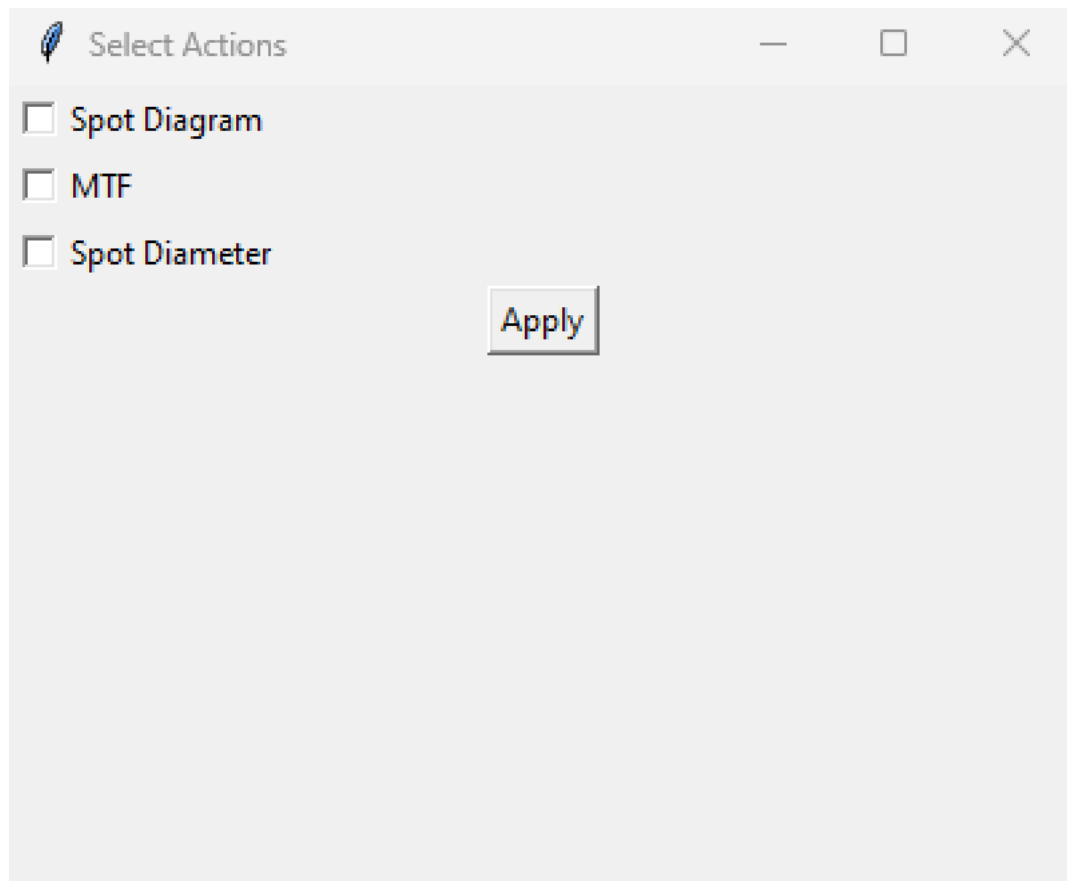
Gives the node IDs, parent IDs, merit function, EFL, and path to the .seq file containing the optimised system



You can choose the .seq file you want from the drop-down menu

**Open:** Opens the selected .seq file

**Action:** Choose to display directly: MTF, spot diagram and spot diameter



**Spot Diagram:** The spot diagram is a graphical representation of the dispersion of light rays that pass through the optical system and strike the image plane. It is essentially a map of how a perfect point of light from an object would be spread out (or "smeared") into a "spot" due to imperfections in the optical system, such as aberrations. A smaller, more concentrated spot diagram is a sign of better optical quality, indicating that the system is producing sharper images with fewer aberrations

**MTF:** MTF is a measure of an optical system's ability to reproduce (or transfer) object detail to the image as a function of spatial frequency. It is usually presented as a curve showing the contrast (or modulation) of the reproduced image as a function of spatial frequency, with higher values indicating better performance. Spatial frequency is measured in cycles per millimetre or lines per millimetre, and describes the level of detail in the object

**Spot diagram:** Represents how the size of the light spots changes as you move to different heights in the field of view