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INTERFACE DOCUMENTATION SHEET

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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.

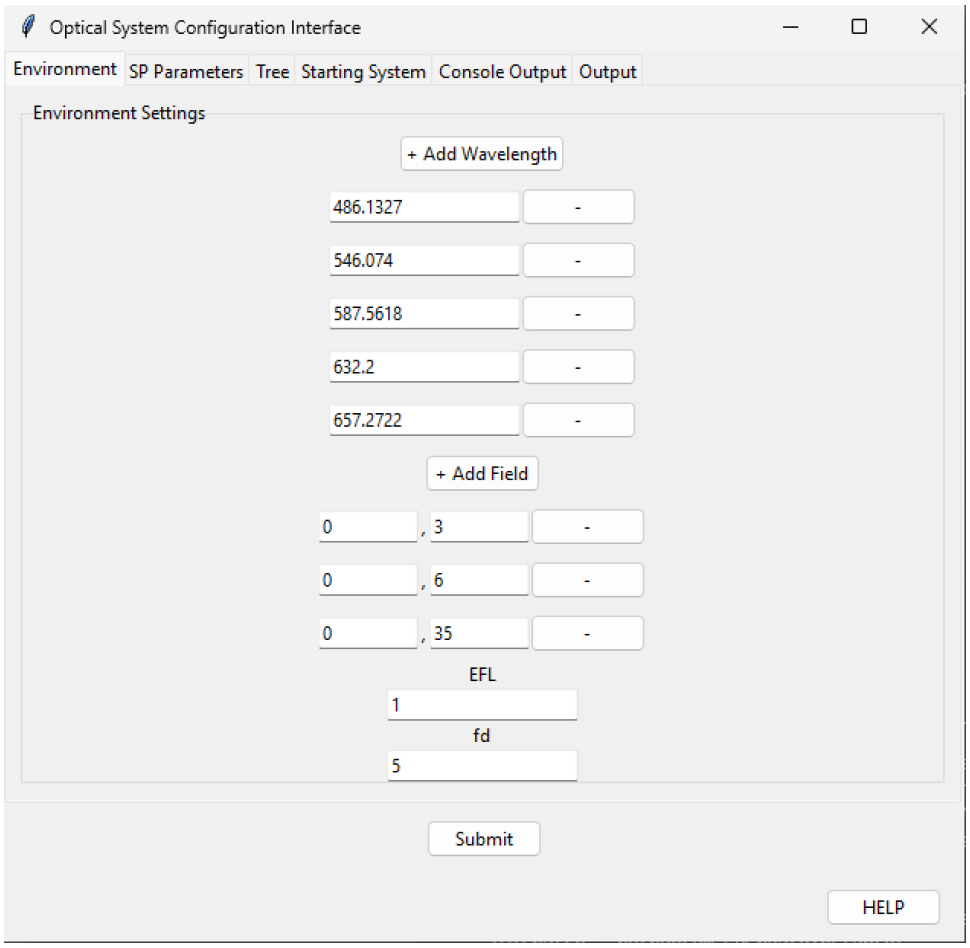
Target audience :

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

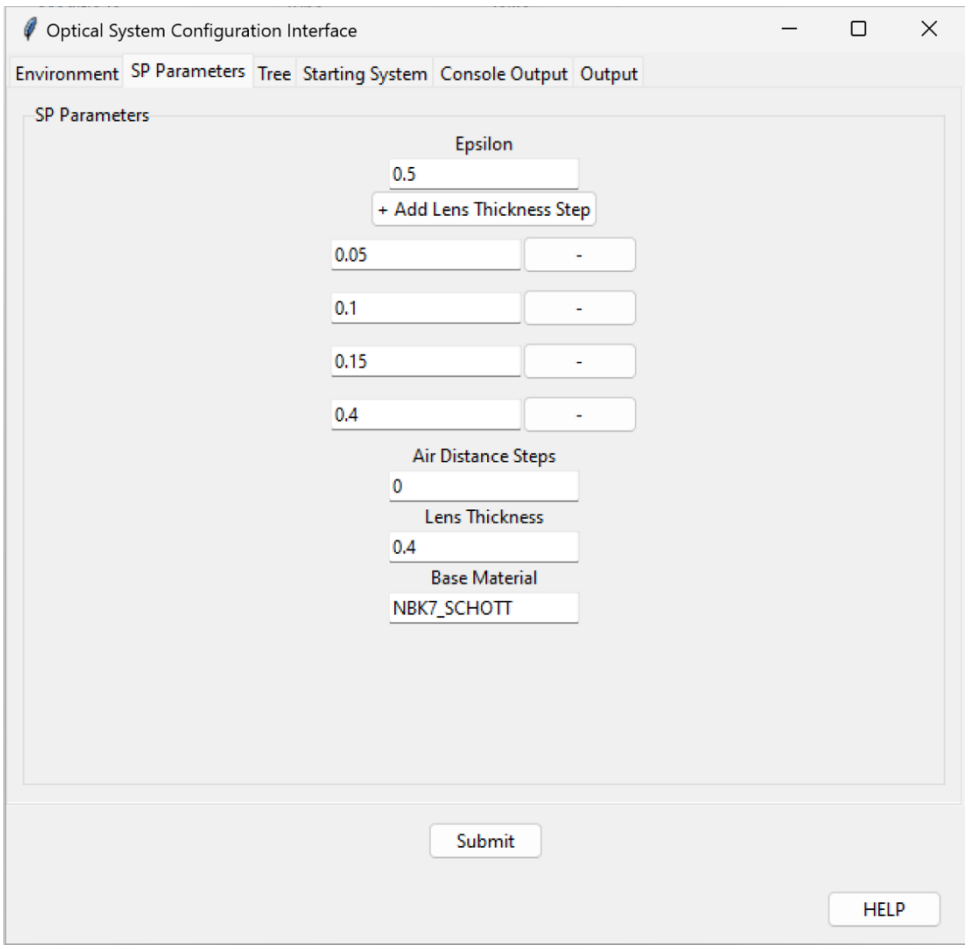


Wavelength: Sets the wavelengths for which the optical system should be optimised, to target superior performance on the light frequencies essential to your specific application

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



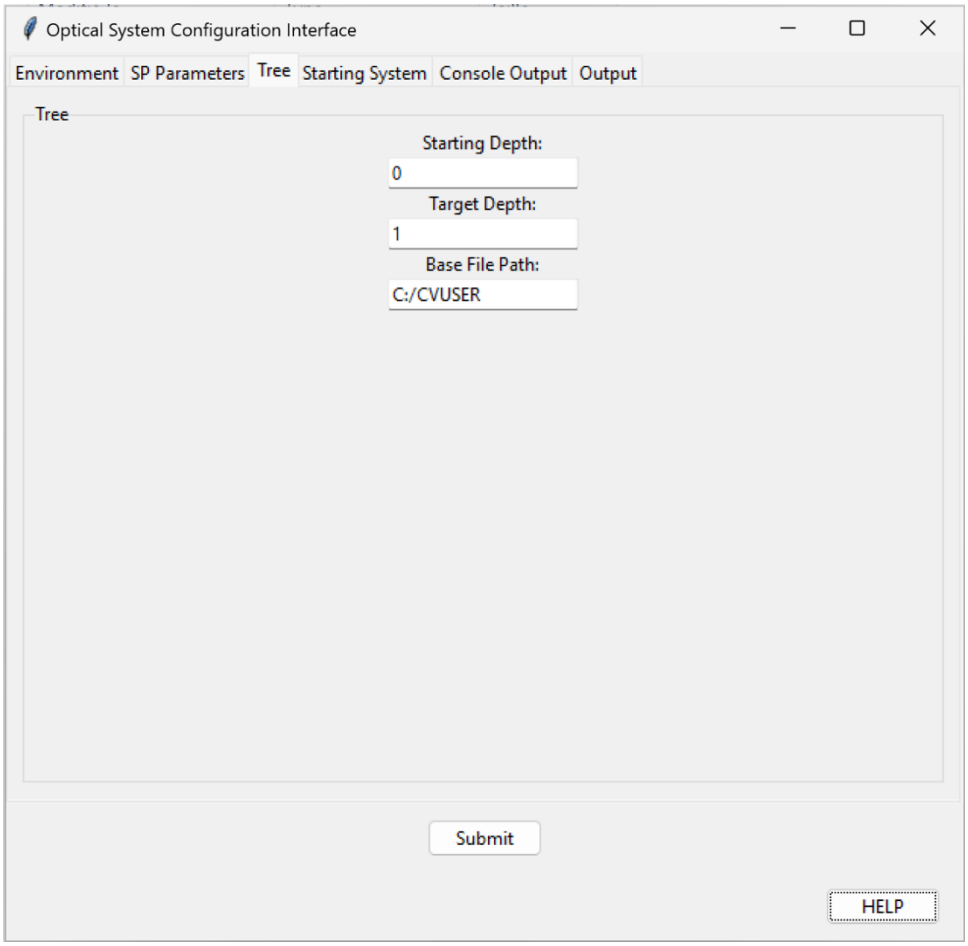
Epsilon: Determines the precision of the convergence of the optimization, which influences the tolerance for stopping the iteration when the solution approaches the saddle point sufficiently

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

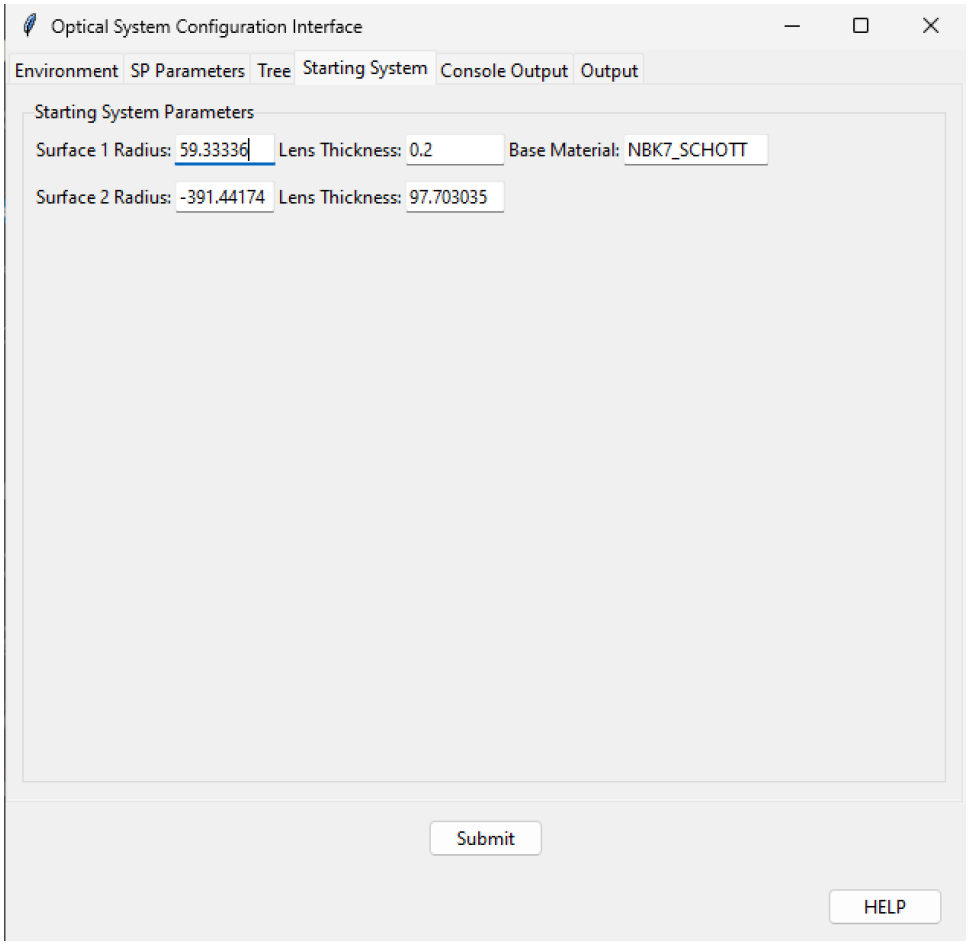
Base material: Determines the lens material used during saddle point optimization



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

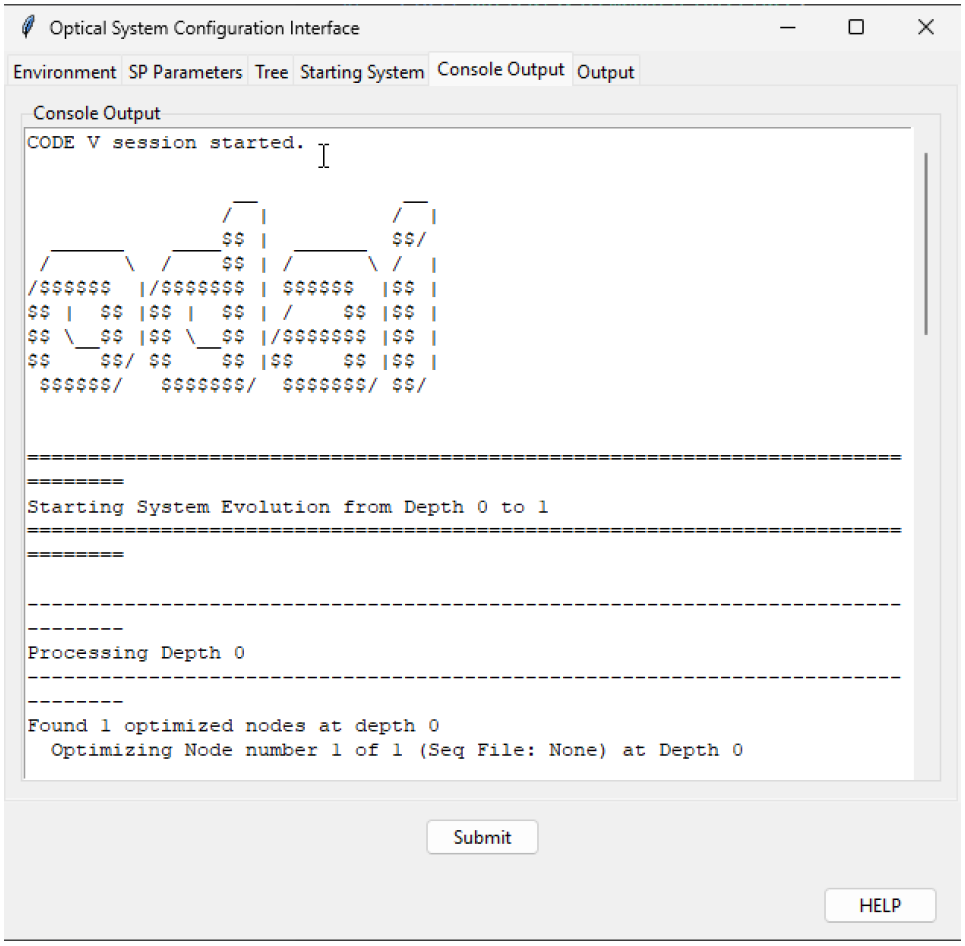
Base File Path: Specifies the file system location where optical system master data and optimisation results will be saved and retrieved



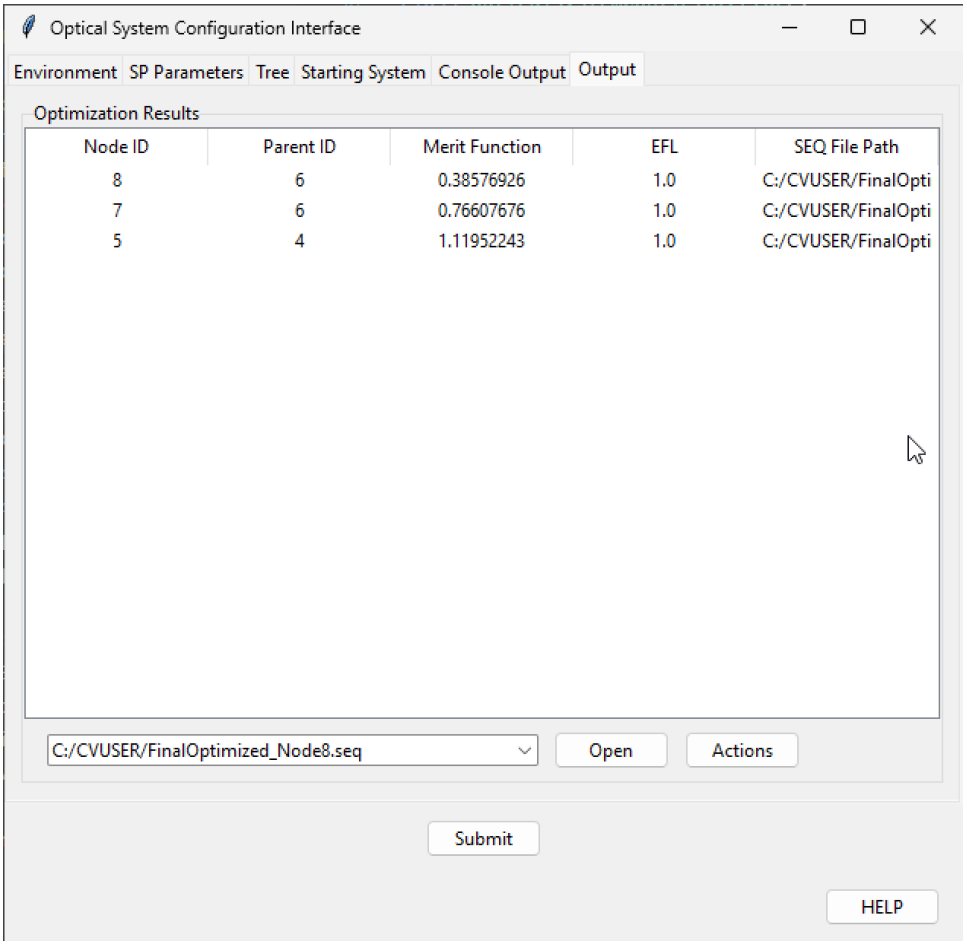
Surface 1 Radius & Surface 2 Radius: Defines the radius of the first and second surfaces of your starting lens to determine the curvature of each face

Lens thickness: Defines the initial thickness for the lens

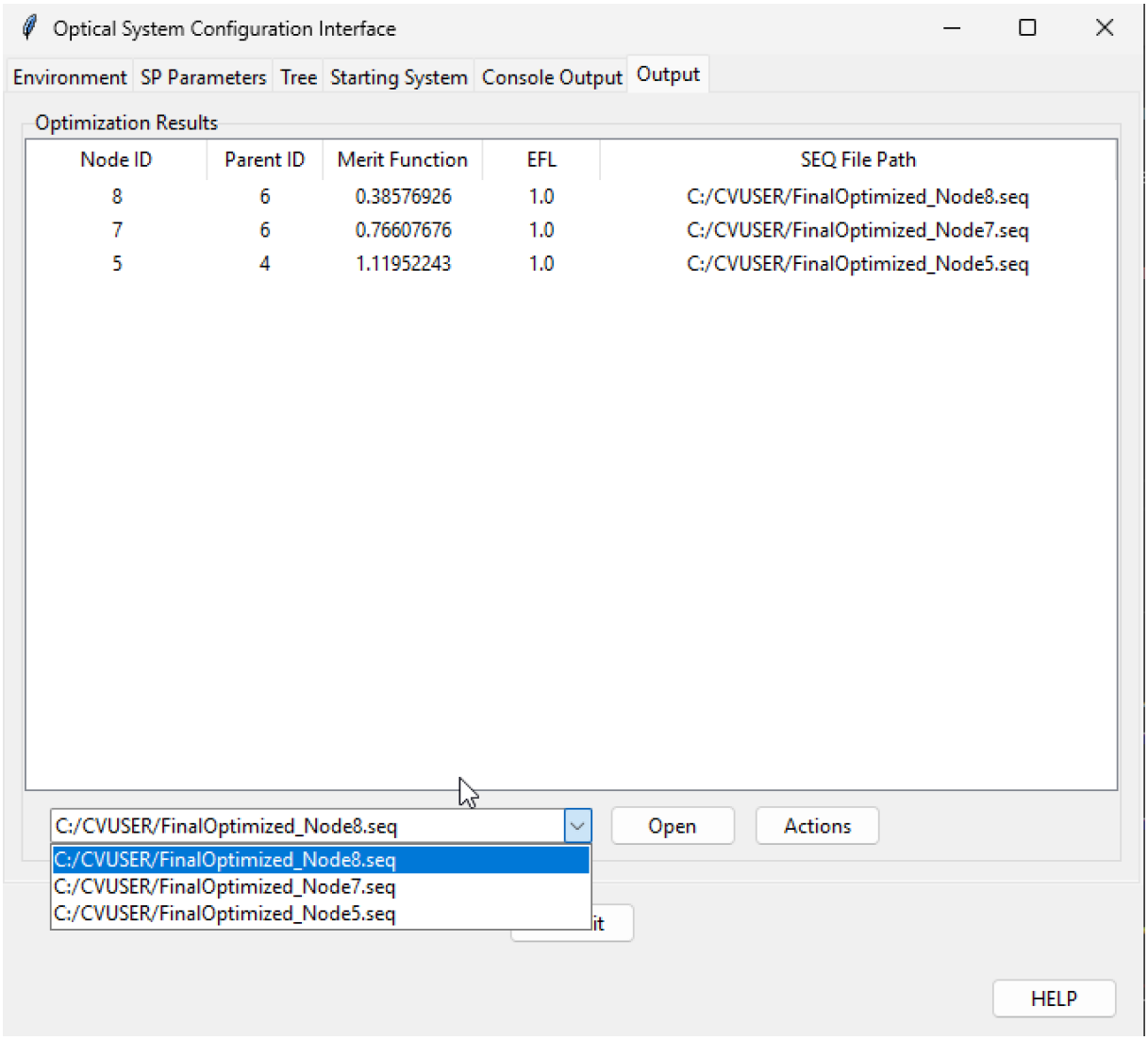
Base material: Selects the base material for the lens, which will be applied evenly to both surfaces of the starting lens



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



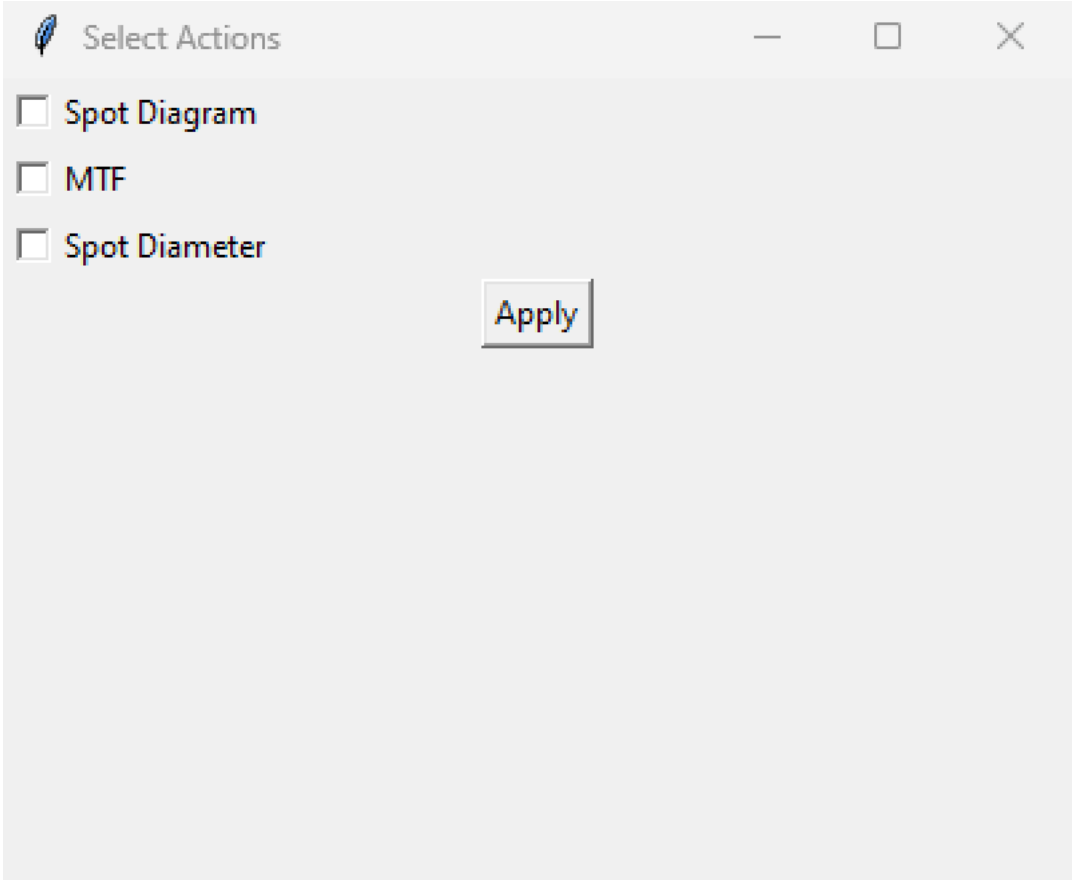
Gives the node IDs, parent IDs, merit function, EFL, and path to the .seq file containing the optimised system



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