

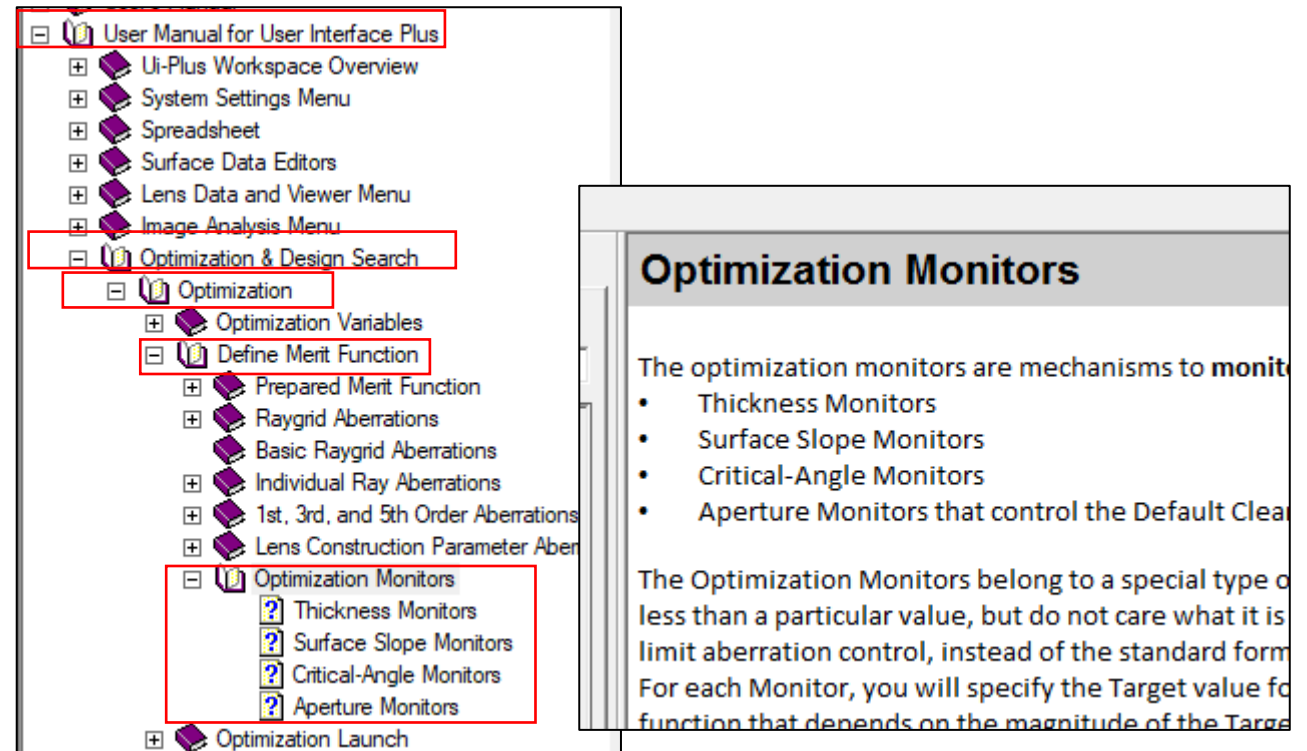
Airspace and Lens Thickness control in DSEARCH

04.25.2023

Airspace control in DSEARCH

When using DSEARCH in SYNOPSIS™, sometimes we find that the airspace in the system is always larger than 1mm even if we use AAE (Automatic Air Edge control, Note 1) monitor with a minimum airspace thickness less than 1mm. It seems like we are not able to make the air space less than 1mm.

Note 1: For more details on the AAE monitor, see User Manual 10.3.7 Edge Feathering Control or the description in the Optimization Monitors in the User Manual for the UP (User-interface Plus) version:



The image shows a software interface with a tree view on the left and a detailed view on the right. The tree view on the left is titled 'User Manual for User Interface Plus' and contains several sub-items. The 'Optimization & Design Search' folder is expanded, showing 'Optimization' and 'Define Merit Function' folders. The 'Optimization Monitors' folder is also expanded, showing 'Thickness Monitors', 'Surface Slope Monitors', 'Critical-Angle Monitors', and 'Aperture Monitors'. The detailed view on the right is titled 'Optimization Monitors' and contains the following text:

The optimization monitors are mechanisms to **monit**

- Thickness Monitors
- Surface Slope Monitors
- Critical-Angle Monitors
- Aperture Monitors that control the Default Clear

The Optimization Monitors belong to a special type of monitor that does not limit aberration control, instead of the standard form of a merit function. For each Monitor, you will specify the Target value for the merit function that depends on the magnitude of the Target

DSEARCH Example

Macro: DS-Airspace-1.MAC

```

DS-Airspace-1.MAC
LOG
CORE 16
TIME
DSEARCH 5 QUIET

SYSTEM
ID TEST DSEARCH
OBB 0 15 3.5
UNI MM
WAVL CDF
END

GOALS
ELEMENTS 5
BACK 10 1
TOTL 20 1
FNUM 4 10
NPASS 50
ANNEAL 200 200
SNAP 10
STOP MIDDLE
STOP FREE
END

SPECIAL PANT
END

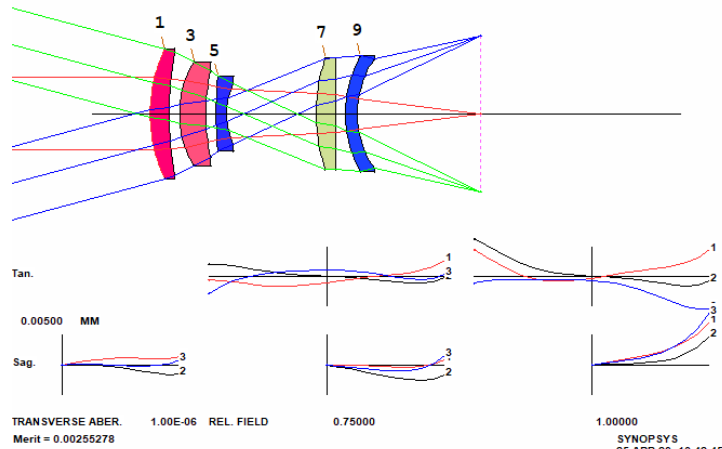
SPECIAL AANT
AAE 0.1 1 1
ACC 5 1 1
ACA 60 1 1
M 0 1 A P YA 1
S GIHT
END

GO
TIME
    
```

This is a sample DSEARCH macro. In this macro, we request the minimum airspace thickness to be 0.1mm by using the AAE monitor:

AAE 0.1 1 1

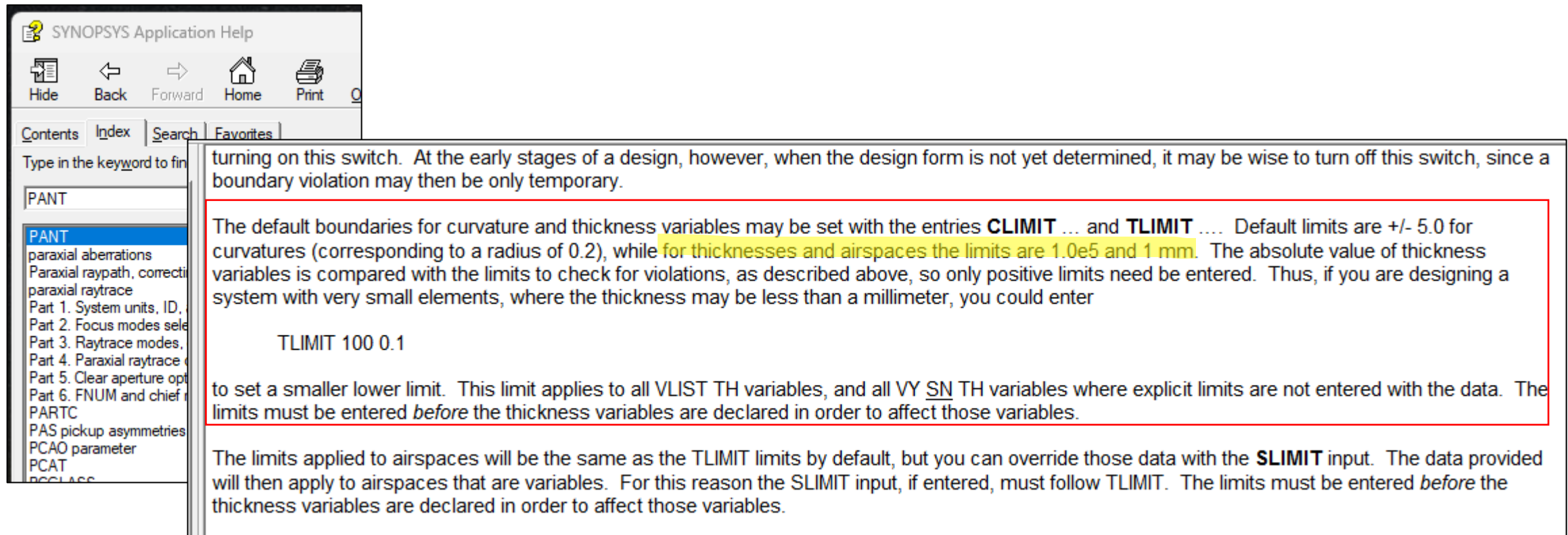
However, the minimum airspace thickness in the systems returned by the search is still not less than 1.



	Surface Type	Surface ID	Radius	Thickness	Material	Index
0	Infinite Object (angular)		infinite	infinite	Air	1
1	Spherical		14.8245275	1.83630391	GLM	1.66462
2	Spherical		36.0867799	1	Air	1
3	Spherical		9.61521535	2.52828339	GLM	1.71278
4	Spherical		18.3744308	1	Air	1
5	Spherical		34.7159866	1	GLM	1.67714
6	Spherical		6.85404108	8.65921247	Air	1
7	Spherical		16.5853674	1.83676404	GLM	1.83427
8	Spherical		430.9688	1	Air	1
9	Spherical		11.4579635	1.13957452	GLM	1.9
10	Spherical		9.22742863	11.9270222	Air	1
11	Flat		infinite	0	Air	1

Reason

The reason for this is that there is a default range for lens thickness, airspace as well as some other variables for DSEARCH. See the User Manual 10.2 Parameter Input for more details:



SYNOPSIS Application Help

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Type in the keyword to find

PANT

PANT

- paraxial aberrations
- Paraxial raypath, correcti
- paraxial raytrace
- Part 1. System units, ID,
- Part 2. Focus modes sele
- Part 3. Raytrace modes,
- Part 4. Paraxial raytrace
- Part 5. Clear aperture opt
- Part 6. FNUM and chief
- PARTC
- PAS pickup asymmetries
- PCAO parameter
- PCAT
- PCCLASP

turning on this switch. At the early stages of a design, however, when the design form is not yet determined, it may be wise to turn off this switch, since a boundary violation may then be only temporary.

The default boundaries for curvature and thickness variables may be set with the entries **CLIMIT** ... and **TLIMIT** Default limits are +/- 5.0 for curvatures (corresponding to a radius of 0.2), while for thicknesses and airspaces the limits are 1.0e5 and 1 mm. The absolute value of thickness variables is compared with the limits to check for violations, as described above, so only positive limits need be entered. Thus, if you are designing a system with very small elements, where the thickness may be less than a millimeter, you could enter

```
TLIMIT 100 0.1
```

to set a smaller lower limit. This limit applies to all VLIST TH variables, and all VY SN TH variables where explicit limits are not entered with the data. The limits must be entered *before* the thickness variables are declared in order to affect those variables.

The limits applied to airspaces will be the same as the TLIMIT limits by default, but you can override those data with the **SLIMIT** input. The data provided will then apply to airspaces that are variables. For this reason the SLIMIT input, if entered, must follow TLIMIT. The limits must be entered *before* the thickness variables are declared in order to affect those variables.

Use TLIMIT and SLIMIT to Change Default Range

As shown in the last slide, by default, the lens and airspace thickness is set between 1 mm and 1E5 mm.

To adjust the limits, we can reset the range of lens thickness and airspace with the TLIMIT (for lens thickness) and SLIMIT (for airspace) directives in the SPECIAL PANT section of the DSEARCH macro.

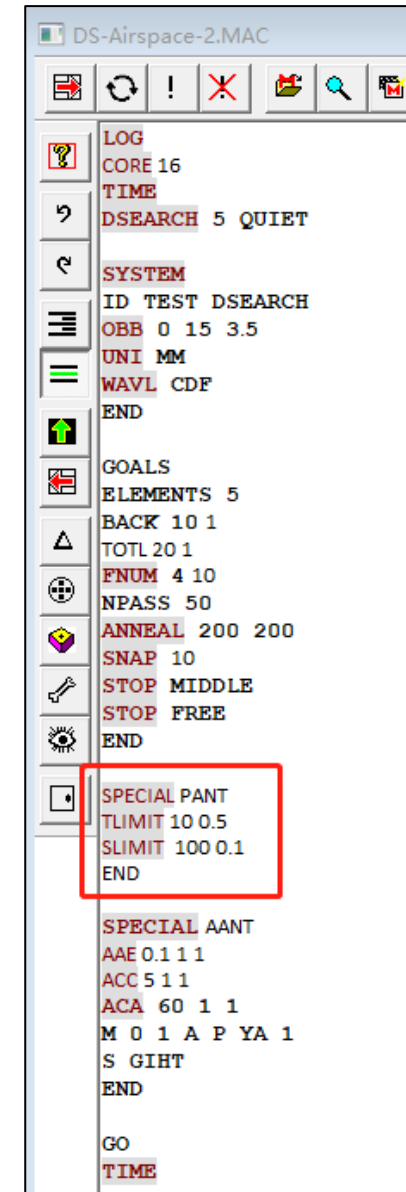
As shown in the macro to the right, in the SPECIAL PANT section, we add the following directives:

```
TLIMIT 10 0.5  
SLIMIT 100 0.1
```

The first line TLIMIT sets the range for the lens thickness to 0.5 – 10 mm

The second line SLIMIT sets the range for the airspace to 0.1 – 100 mm.

Macro: DS-Airspace-2.MAC

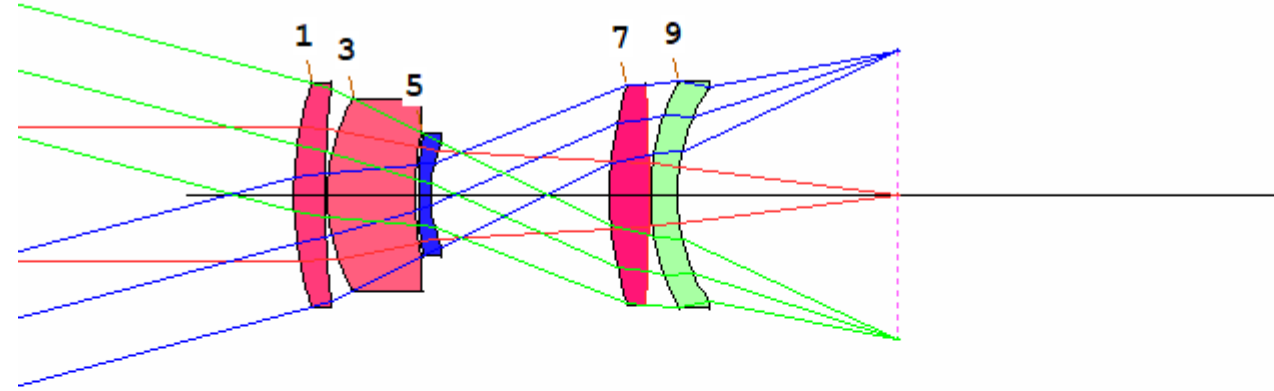


```
LOG  
CORE 16  
TIME  
DSEARCH 5 QUIET  
SYSTEM  
ID TEST DSEARCH  
OBB 0 15 3.5  
UNI MM  
WAVL CDF  
END  
GOALS  
ELEMENTS 5  
BACK 10 1  
TOTL 20 1  
FNUM 4 10  
NPASS 50  
ANNEAL 200 200  
SNAP 10  
STOP MIDDLE  
STOP FREE  
END  
SPECIAL PANT  
TLIMIT 10 0.5  
SLIMIT 100 0.1  
END  
SPECIAL AANT  
AAE 0.1 1 1  
ACC 5 1 1  
ACA 60 1 1  
M 0 1 A P YA 1  
S GIHT  
END  
GO  
TIME
```

New DSEARCH Results

File: AIRSPACE_2.RLE

The airspace and thickness of the lens from the new macro now can go down to 0.1 mm.



	Surface Type	Surface ID	Radius	Thickness	Material	Index
0	Infinite Object (angular)		infinite	infinite	Air	1
1	Spherical		18.446502	1.63982617	GLM	1.70032
2	Spherical		57.0386229	0.1	Air	1
3	Spherical		9.79208831	4.6003764	GLM	1.72165
4	Spherical		16.5917487	0.19831282	Air	1
5	Spherical		28.9166165	0.58069726	GLM	1.69306
6	Spherical		6.83192699	9.33186869	Air	1
7	Spherical		17.8260288	2.06459032	GLM	1.67919
8	Spherical		-99.3616687	0.1	Air	1
9	Spherical		12.4630673	1.38440805	GLM	1.9
10	Spherical		10.1657956	11.5133385	Air	1
11	Flat		infinite	0	Air	1
12						

