Use of dummy surfaces for distribution of TDC declarations to achieve selective TDC pick-up in multi-configuration optimization

12/04/2023

Solution

As explained in the user manual (10.7.2 Alternate Configurations), the PAS command in the ACON PICKUPS module will pick up all types of asymmetries assigned to the specified surface It means that all the assigned tilt and decenter parameters (including AT and BT) at the same surface will be picked-up between ACONS.

If one wants to only pickup certain asymmetries at a specific surface between different ACONs (and leaving the other asymmetries out of the Pick-up group), one can achieve this by utilizing dummy surfaces attached to the real surface and distribute the asymmetries over these surfaces (the real surface and the dummy surfaces) so that the Pickup assigned to a certain surface will have effect only on the subgroup of asymmetries assigned to that surface.

For example, in a multi-configuration optimization, for an element with both alpha and beta tilts (AT and BT) assigned to it, if we only want to pick-up the AT between different ACONs but keep BT independent between ACONs, we can add a dummy surface to the front surface of the element for the BT assignment (instead of assigning both AT and BT to the same real surface). Then when we construct the ACON pick-up, we only apply PAS pick-up to the surface where AT is defined and leave this dummy surface alone.

We use a simple Cooke triplet as an example to demonstrate this approach in the next few slides.

The relationship between each alternate configuration and the others is defined by one or more files of the format :

Multiconfiguration optimization:

ACON [CLEAR / ENFORCE]
ACON NB
ACON NB NULL

ACON NB PICKUPS
SNA { PCV / PTH / PIN / PAS / PCAO } SNM [ACONF]

1 PZDATA 1 [ACONF]
1 PACCOM 1 [ACONF]
1 POB 1 [ACONF]
[-]SNM { HP1 / HP2 / HZ1 / HZ2 }

[[B/C]ZOOM [JSSS JSPS JFROMSURF]]
END

Commands to be used in the Pickup module

NB is the configuration to get the picked-up data (1 to 6), and **ACONF** is the configuration whose data are to be picked up (default is configuration 1).

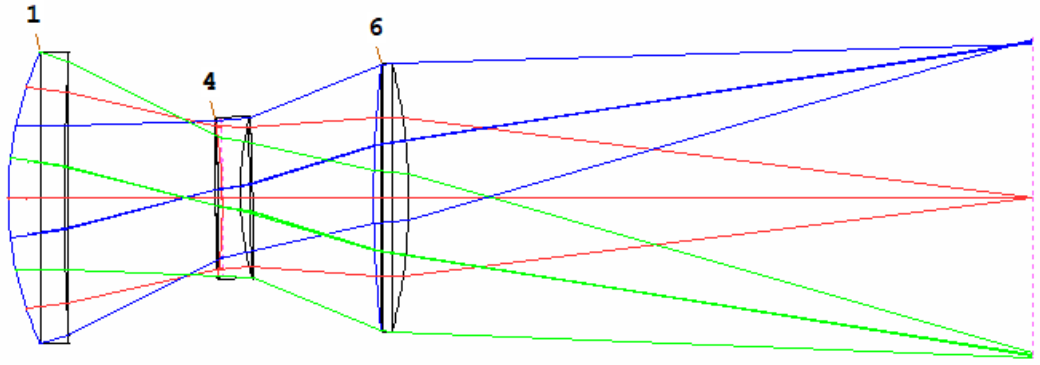
PAS	indicates that the asymmetries (tilts and decenters) are to be picked up. This will pick up all types of asymmetries: relative, local, and global.

Example

We will start with a simple Cooke triplet with an 1 degree AT and an 1 degree BT at the center element.

For this Cooke triplet, we have built it with a dummy surface (surface 3) attached to the center element that consists of surface 4 and 5.

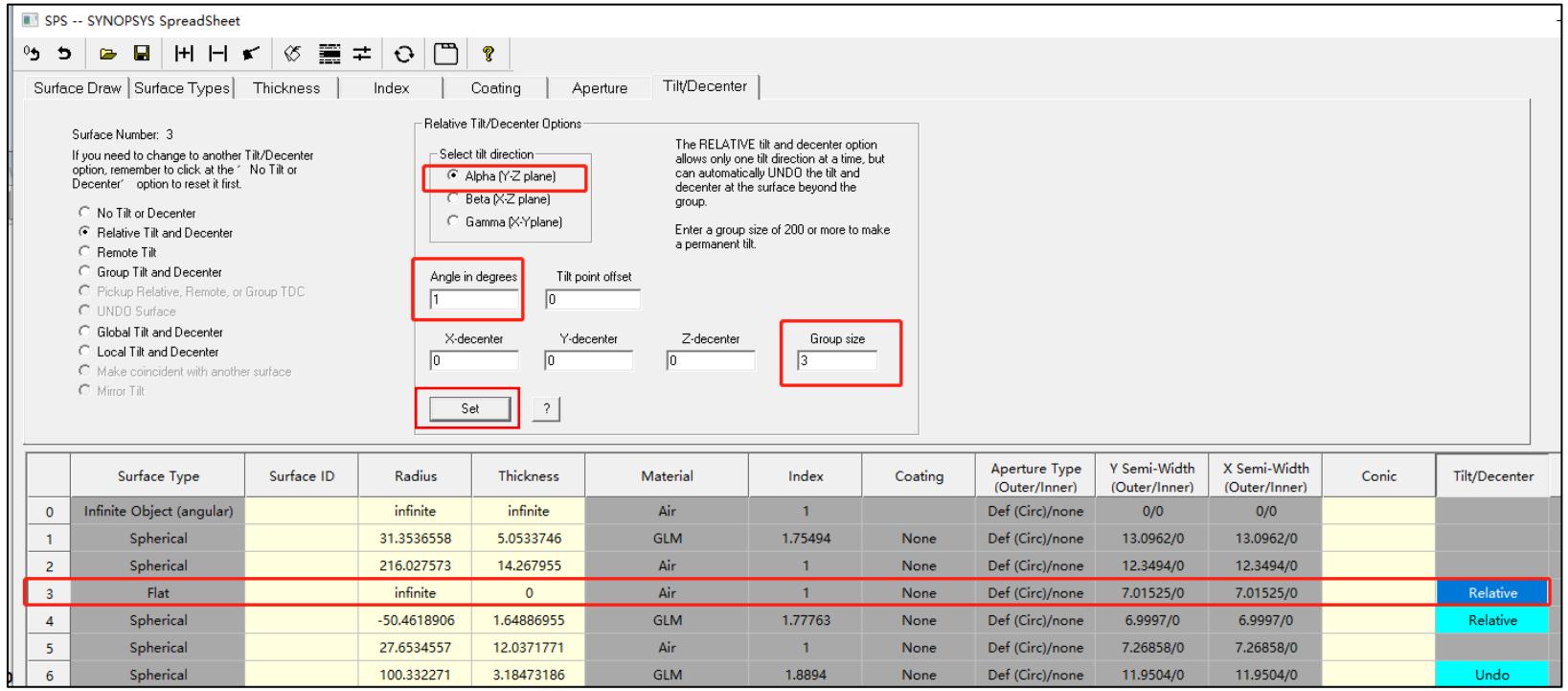
As shown in the next 2 slides, the AT is assigned to the dummy surface (surface 3) and BT to the front surface of the lens (surface 4).



Lens file: COOKETRIPLET_1129.RLE

	Surface Type	Surface ID	Radius	Thickness	Material	Index	Coating	Aperture Type (Outer/Inner)	Y Semi-Width (Outer/Inner)	X Semi-Width (Outer/Inner)
0	Infinite Object (angular)		infinite	infinite	Air	1		Def (Circ)/none	0/0	0/0
1	Spherical		31.3536558	5.0533746	GLM	1.75494	None	Def (Circ)/none	13.0962/0	13.0962/0
2	Spherical		216.027573	14.267955	Air	1	None	Def (Circ)/none	12.3494/0	12.3494/0
3	Flat		infinite	0	Air	1	None	Def (Circ)/none	7.01525/0	7.01525/0
4	Spherical		-50.4618906	1.64886955	GLM	1.77763	None	Def (Circ)/none	6.9997/0	6.9997/0
5	Spherical		27.6534557	12.0371771	Air	1	None	Def (Circ)/none	7.26858/0	7.26858/0
6	Spherical		100.332271	3.18473186	GLM	1.8894	None	Def (Circ)/none	11.9504/0	11.9504/0
7	Spherical		-49.1369385	56.3515283	Air	1	None	Def (Circ)/none	12.0805/0	12.0805/0
8	Flat		infinite	0	Air	1	None	Def (Circ)/none	14.375/0	14.375/0

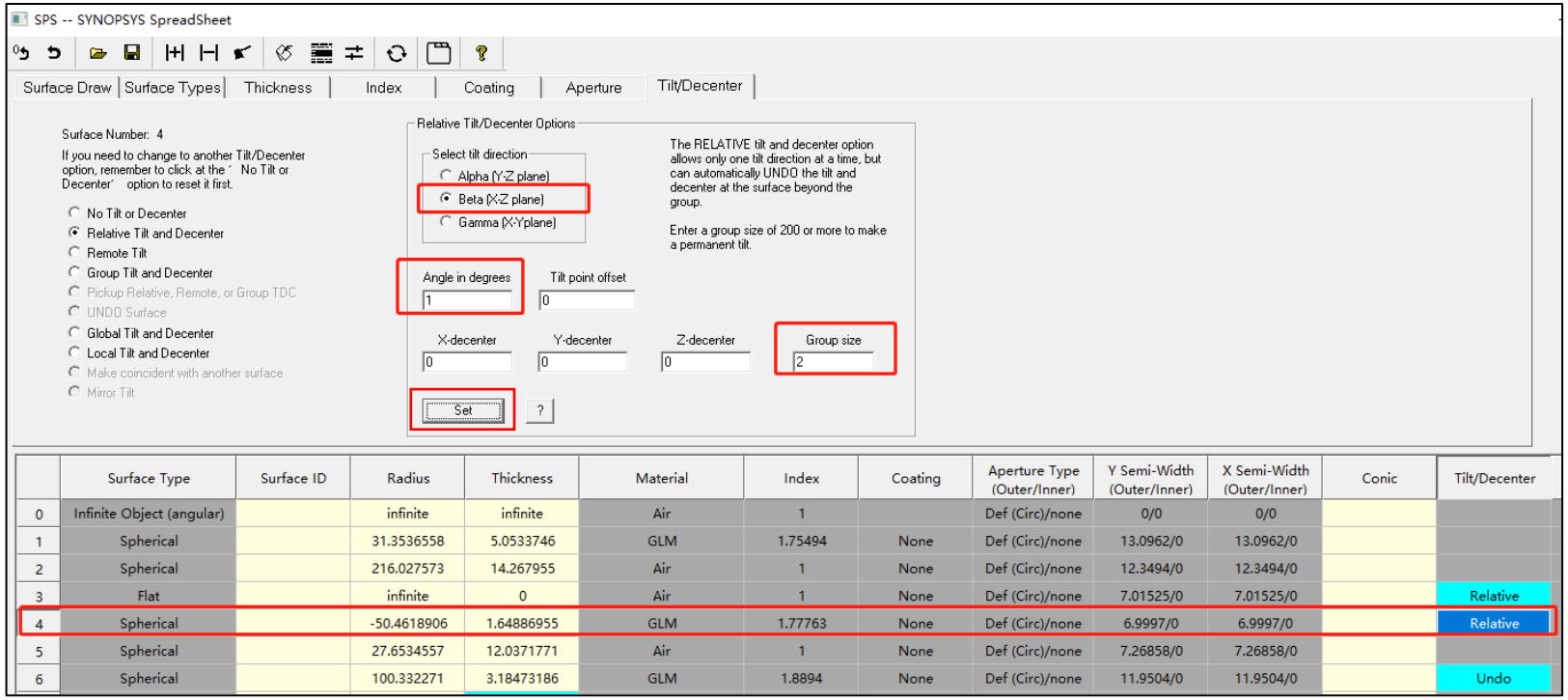
First, at the dummy surface (surface 3 with thickness 0), set an AT of 1 degree using the Tilt/Decenter (TDC) Editor in the Spreadsheet. Then enter 3 for the group size so that this dummy surface, the front, and the back surfaces of the center elements are in the same TDC group.



	Surface Type	Surface ID	Radius	Thickness	Material	Index	Coating	Aperture Type (Outer/Inner)	Y Semi-Width (Outer/Inner)	X Semi-Width (Outer/Inner)	Conic	Tilt/Decenter
0	Infinite Object (angular)		infinite	infinite	Air	1		Def (Circ)/none	0/0	0/0		
1	Spherical		31.3536558	5.0533746	GLM	1.75494	None	Def (Circ)/none	13.0962/0	13.0962/0		
2	Spherical		216.027573	14.267955	Air	1	None	Def (Circ)/none	12.3494/0	12.3494/0		
3	Flat		infinite	0	Air	1	None	Def (Circ)/none	7.01525/0	7.01525/0		Relative
4	Spherical		-50.4618906	1.64886955	GLM	1.77763	None	Def (Circ)/none	6.9997/0	6.9997/0		Relative
5	Spherical		27.6534557	12.0371771	Air	1	None	Def (Circ)/none	7.26858/0	7.26858/0		
6	Spherical		100.332271	3.18473186	GLM	1.8894	None	Def (Circ)/none	11.9504/0	11.9504/0		Undo

Next, assign a BT of one degree to front surface of the center element (surface 4). Set group size 2 so that the front and back surfaces are tilted together.

This distribution of AT and BT onto different surface groups allows us to selectively pick up the AT at surface 3 with PAS in the ACON Pickup module, and leave the BT (assigned to surface 4) out of the Pickup and can be varied independently.

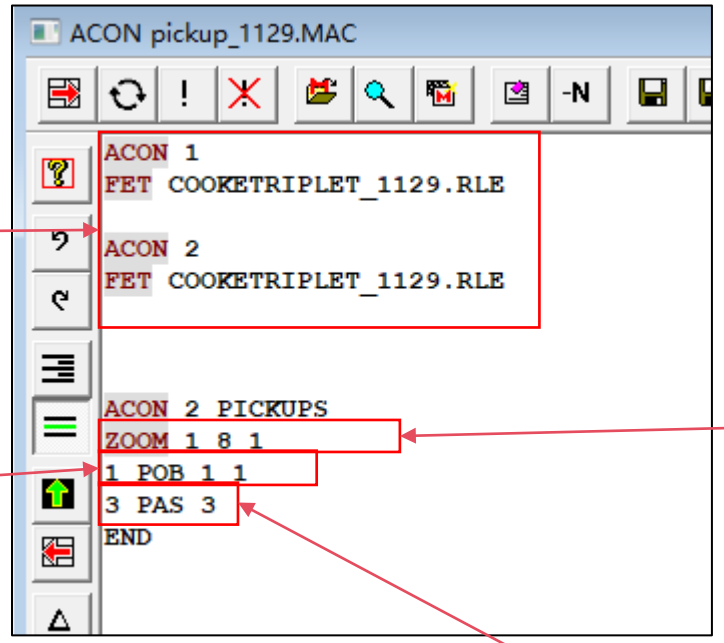


	Surface Type	Surface ID	Radius	Thickness	Material	Index	Coating	Aperture Type (Outer/Inner)	Y Semi-Width (Outer/Inner)	X Semi-Width (Outer/Inner)	Conic	Tilt/Decenter
0	Infinite Object (angular)		infinite	infinite	Air	1		Def (Circ)/none	0/0	0/0		
1	Spherical		31.3536558	5.0533746	GLM	1.75494	None	Def (Circ)/none	13.0962/0	13.0962/0		
2	Spherical		216.027573	14.267955	Air	1	None	Def (Circ)/none	12.3494/0	12.3494/0		
3	Flat		infinite	0	Air	1	None	Def (Circ)/none	7.01525/0	7.01525/0		Relative
4	Spherical		-50.4618906	1.64886955	GLM	1.77763	None	Def (Circ)/none	6.9997/0	6.9997/0		Relative
5	Spherical		27.6534557	12.0371771	Air	1	None	Def (Circ)/none	7.26858/0	7.26858/0		
6	Spherical		100.332271	3.18473186	GLM	1.8894	None	Def (Circ)/none	11.9504/0	11.9504/0		Undo

ACON Pickup

Launch the lens to ACON 1 and 2

Makes the object data declared in ACON 1 to be picked up by ACON 2.



Makes all radii, thicknesses and airspaces,and indices to be picked up from ACON 1 by ACON 2. It means that surfaces 1 through 8 in ACON 2 to be the same as ACON 1 after the optimization.

Make the asymmetries at surface 3 (ie, AT at the dummy surface) of ACON 1 to be picked up by ACON 2.
Note that the BT at surface 4 is not included in this Pickup declaration. We will instead declare it as an independent optimization variable to ACON 2 in the PANT file of the optimization macro (see next slide) so that it can change independently without affecting the BT ACON 1.

For a more detailed description of the pickup directives, see ACON Pickups in the second half of the User Manual 10.7.2, Alternate Configurations

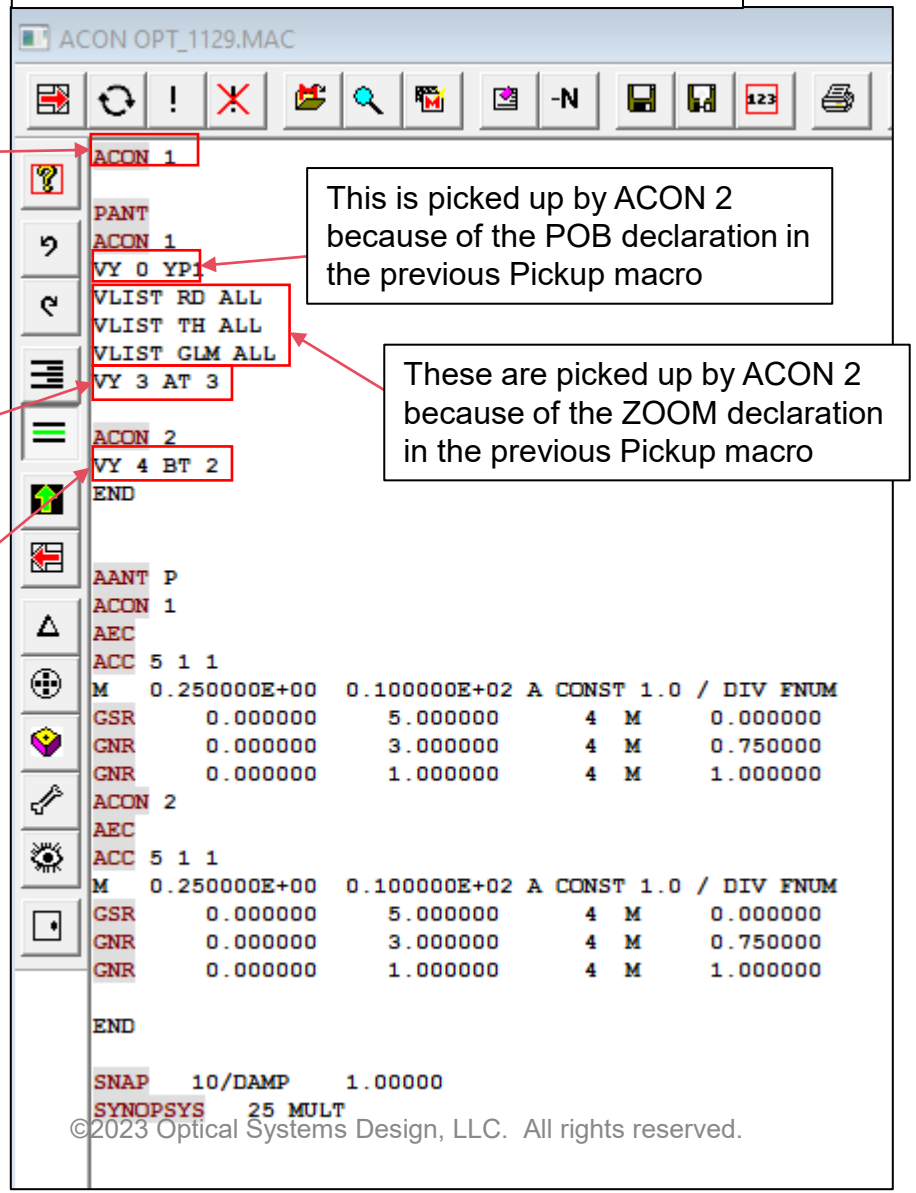
ACON optimization

Inform SYNOPSYS to start the optimization with ACON 1. Otherwise, SYNOPSYS will start the optimization with the current active ACON (which can be different from ACON 1). It's a good practice to include this line at the top of the optimization macro.

AT is picked up by ACON 2 because of the PAS declaration in the previous Pickup macro

BT will only change in ACON 2 because it's not included in any pick-up declaration

Optimization macro: ACON OPT_1129.mac



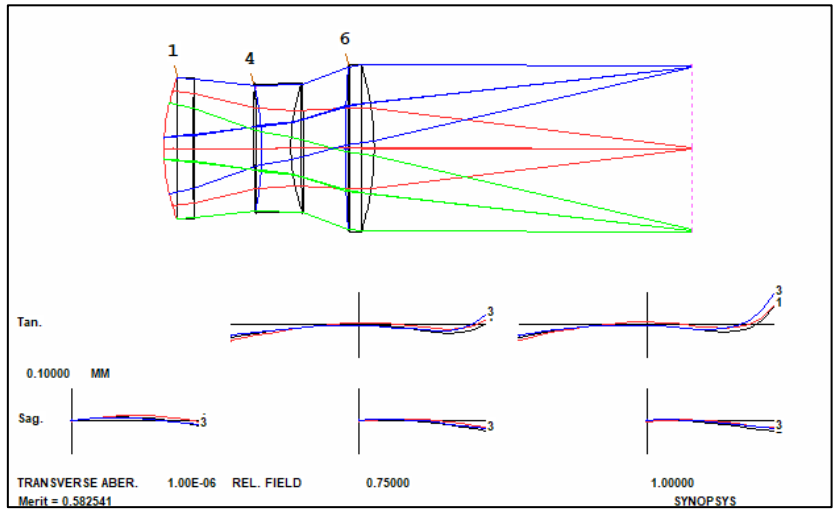
This is picked up by ACON 2 because of the POB declaration in the previous Pickup macro

These are picked up by ACON 2 because of the ZOOM declaration in the previous Pickup macro

Optimization result, ACON 1

This is the lens after optimization in ACON 1 (COOKETRIPLET_1129_OPT_ACON1.RLE).

- At surface 3, AT is changed to 0.40663275 from 1.
- At surface 4, BT maintains the same at 1 because it's not set as an optimization variable for ACON 1.

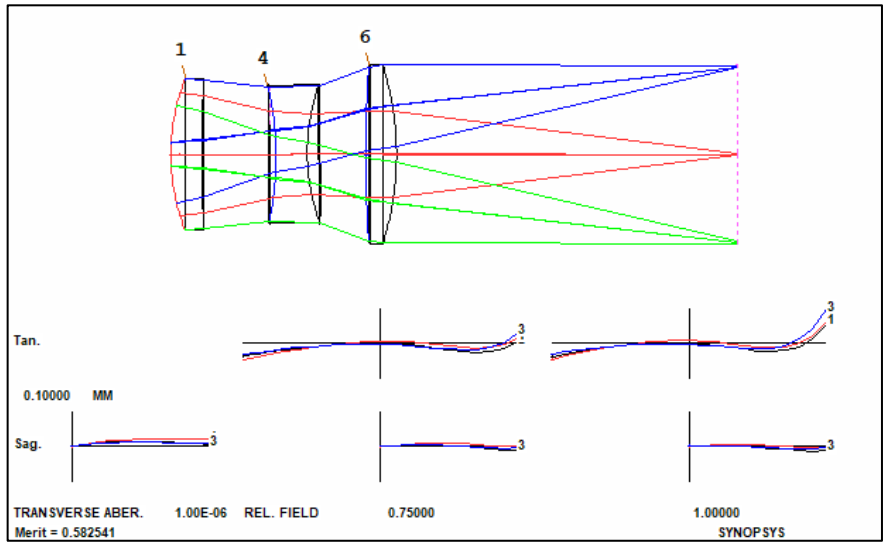



```
 RLE
ID                                                    1
ID1 DSEARCH CASE WAS 00000000000000000000000111      7
 FNAME 'COOKETRIPLET_1129.RLE
 MERIT   0.582541
 LOG         1
 WAVL .6562700 .5875600 .4861300
 APS                 1
 GLOBAL
 UNITS MM
 OBB   0.0000000  10.0000000   10.0000000   1.88499525699       0.0
   0 AIR
   1 RAD      33.5134195633676   TH       5.14346719
   1 GLM       1.733915275              54.701353861
   2 RAD     481.5881285232390   TH      11.07758980 AIR
   3 CV        0.0000000000000   TH       1.00000000 AIR
   3 DECEN       0.00000000       0.00000000       0.00000000     3
   3 AT        0.40663275       0.00000000     3
   4 RAD     -51.3531368355459   TH       5.11278597
   4 GLM       1.725401498              27.924634958
   4 DECEN       0.00000000       0.00000000       0.00000000     2
   4 BT        1.00000000       0.00000000     2
   5 RAD      33.2744217651162   TH       9.54841155 AIR
   6 RAD     192.2083689932883   TH       5.04166883
   6 GLM       1.900000000              38.476153846
```

Optimization result, ACON 2

This is the lens after optimization in ACON 2 (COOKETRIPLET_1129_OPT_ACON2.RLE).

- At surface 3, AT is changed to 0.40663275 from 1, same as ACON 1 because of the PAS pick-up.
- At surface 4, BT is changed to 0.57089676 because it's set as an optimization variable for ACON 2 alone.




```
 RLE
ID                                                  9
ID1 DSEARCH CASE WAS 00000000000000000000000111      7
 FNAME 'COOKETRIPLET_1129_OPT_ACON2.RLE
 MERIT   0.582541
 LOG        9
 WAVL .6562700 .5875600 .4861300
 APS               1
 GLOBAL
 UNITS MM
 OBB  0.0000000  10.0000000   10.0000000   1.88499525699       0.0000000   0
   0 AIR
   1 RAD      33.5134195633676   TH      5.14346719
   1 GLM       1.733915275              54.701353861
   2 RAD     481.5881285232390   TH     11.07758980 AIR
   3 CV        0.0000000000000   TH      1.00000000 AIR
   3 DECEN       0.00000000       0.00000000       0.00000000     3
   3 AT        0.40663275       0.00000000     3
   4 RAD     -51.3531368355459   TH      5.11278597
   4 GLM       1.725401498              27.924634958
   4 DECEN       0.00000000       0.00000000       0.00000000     2
   4 BT        0.57089676       0.00000000     2
   5 RAD      33.2744217651162   TH      9.54841155 AIR
   6 RAD     192.2083689932883   TH      5.04166883
   6 GLM       1.900000000              38.476153846
   7 RAD     -49.2881072435922   TH     55.74230352 AIR
   8 CV        0.0000000000000   TH      0.00000000 AIR
END
```

Conclusion

- By distributing the TDC to additional dummy surface(s), we are able to specify AT as a pickup variable shared between ACON 1 and 2, while BT would be excluded from the pick-up and only changes for ACON 2.