



Optical Reflector Design using the TracePro Interactive Optimizer

Presented by :
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Format

- A 25-30 minute presentation followed by a 10-15 minute question and answer session
- Please submit your questions anytime using Question box in the GoToWebinar control panel



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In this webinar you will:

- Learn how to use the TracePro Interactive Optimizer to design optical reflectors.
- Find out how the Interactive Optimizer uses the Surface Property catalog in TracePro to model different reflector coatings.
- Discover how you can use the Scheme macro language in conjunction with the Interactive Optimizer to expand its capabilities.

In this webinar you will:

- Gain an understanding on how to set up your sources and targets in TracePro and define suitable optimization targets.
- See examples of reflector designs created using the Interactive Optimizer such as trough reflectors with curved ends, faceted reflectors with non-uniform faceting, and off-axis reflector segments.
- Have your questions answered in the Question and Answer session.

Additional Resources

- Past TracePro Webinars
 - February 2010 - ***Interactive Optimizer***
 - March 2010 - ***Interactive Optimizer***
 - July 2010 - ***Modeling Light Sources in TracePro***
 - September 2010 - ***Interactive Optimizer***
 - February 2011 - ***Analysis Tools in TracePro***
 - June 2011 - ***LED Lighting Design using TracePro***
 - July 2011 - ***Scheme Macro Language***

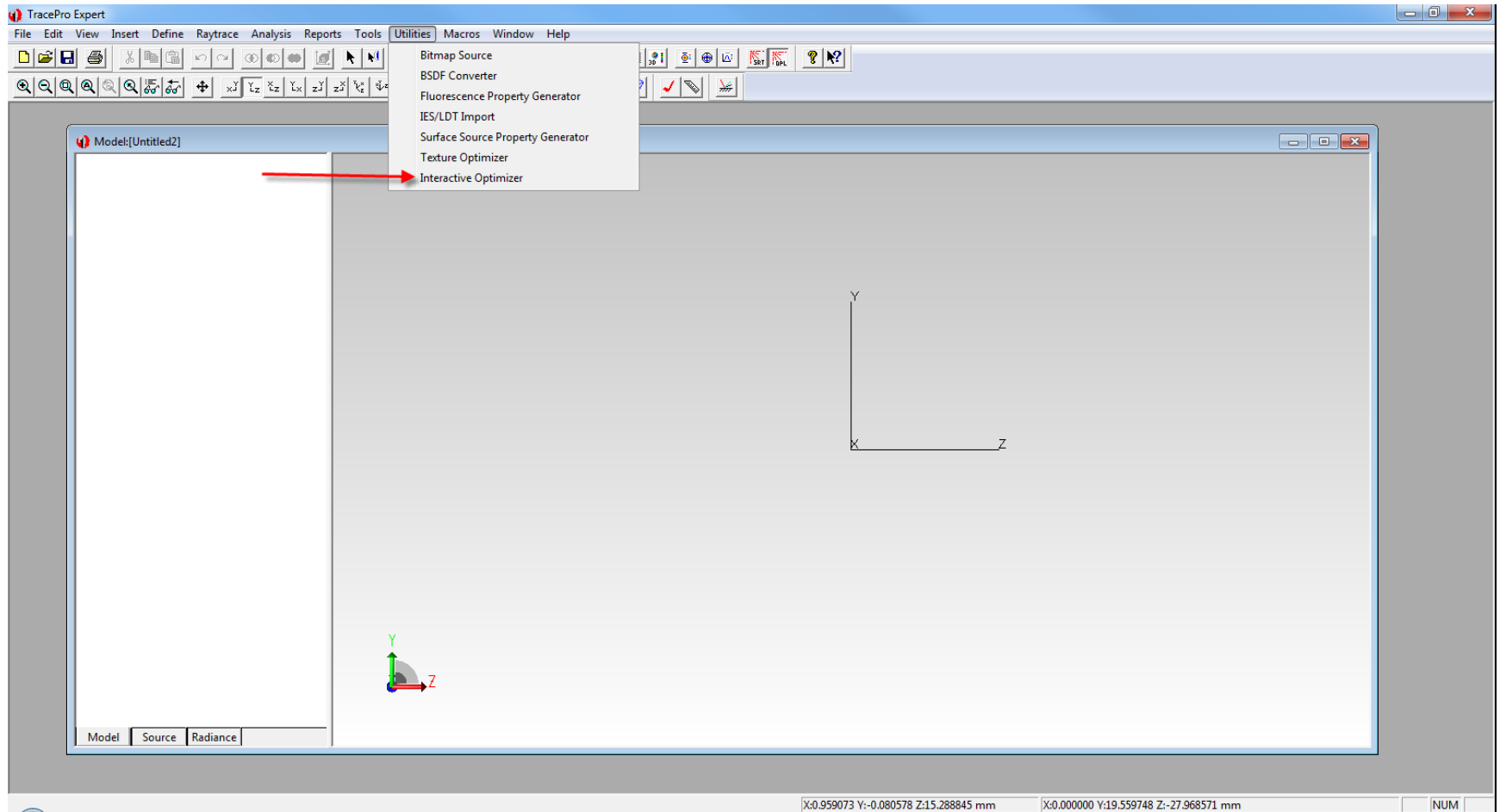
Download at <http://www.lambdares.com/webinars/>

Current TracePro Release

- TracePro 7.1.2
- Can be downloaded by anyone with a current Maintenance and Support Agreement
- www.lambdares.com

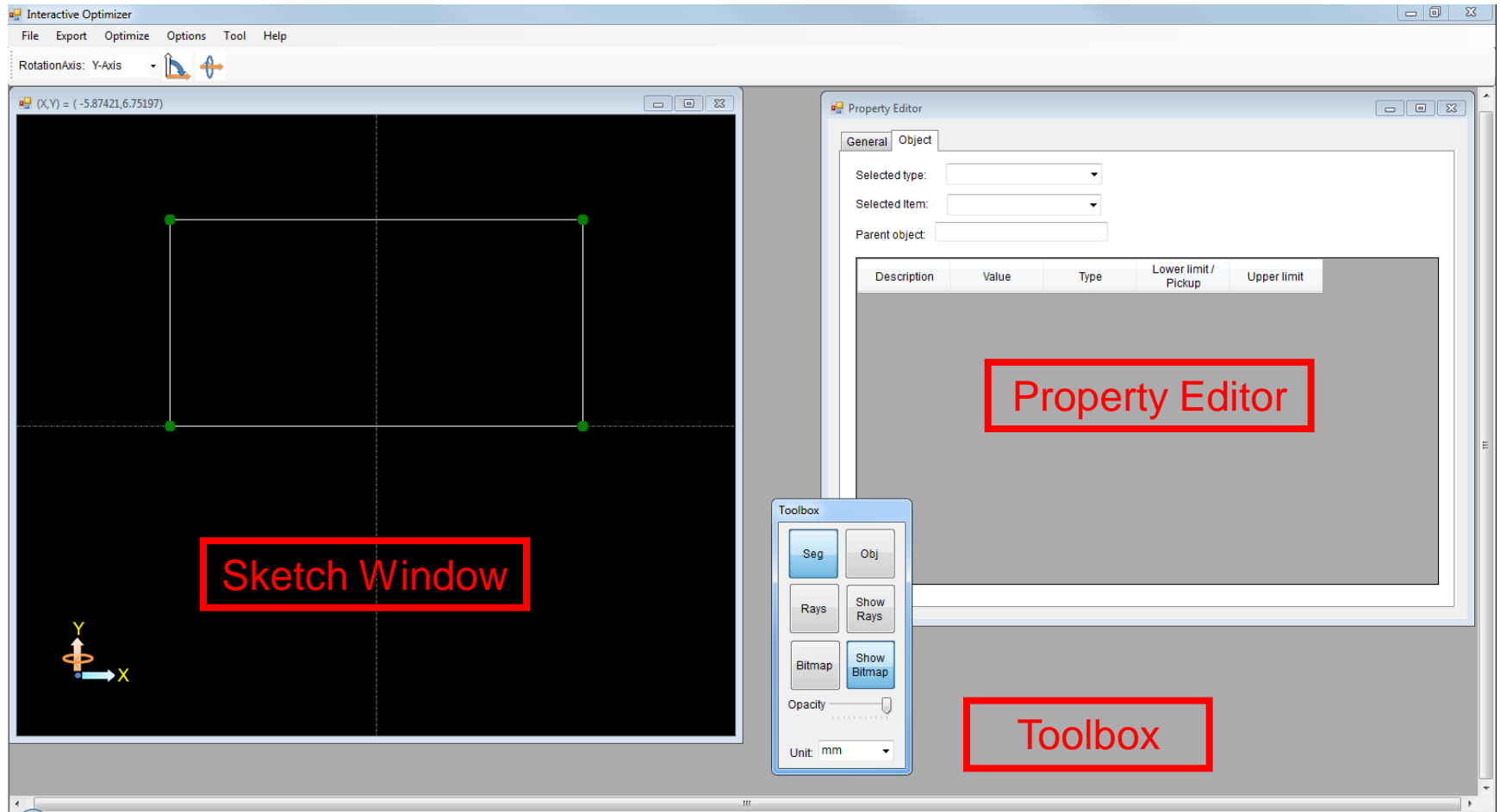
Optical Reflector Design using the TracePro Interactive Optimizer

TracePro Interactive Optimizer



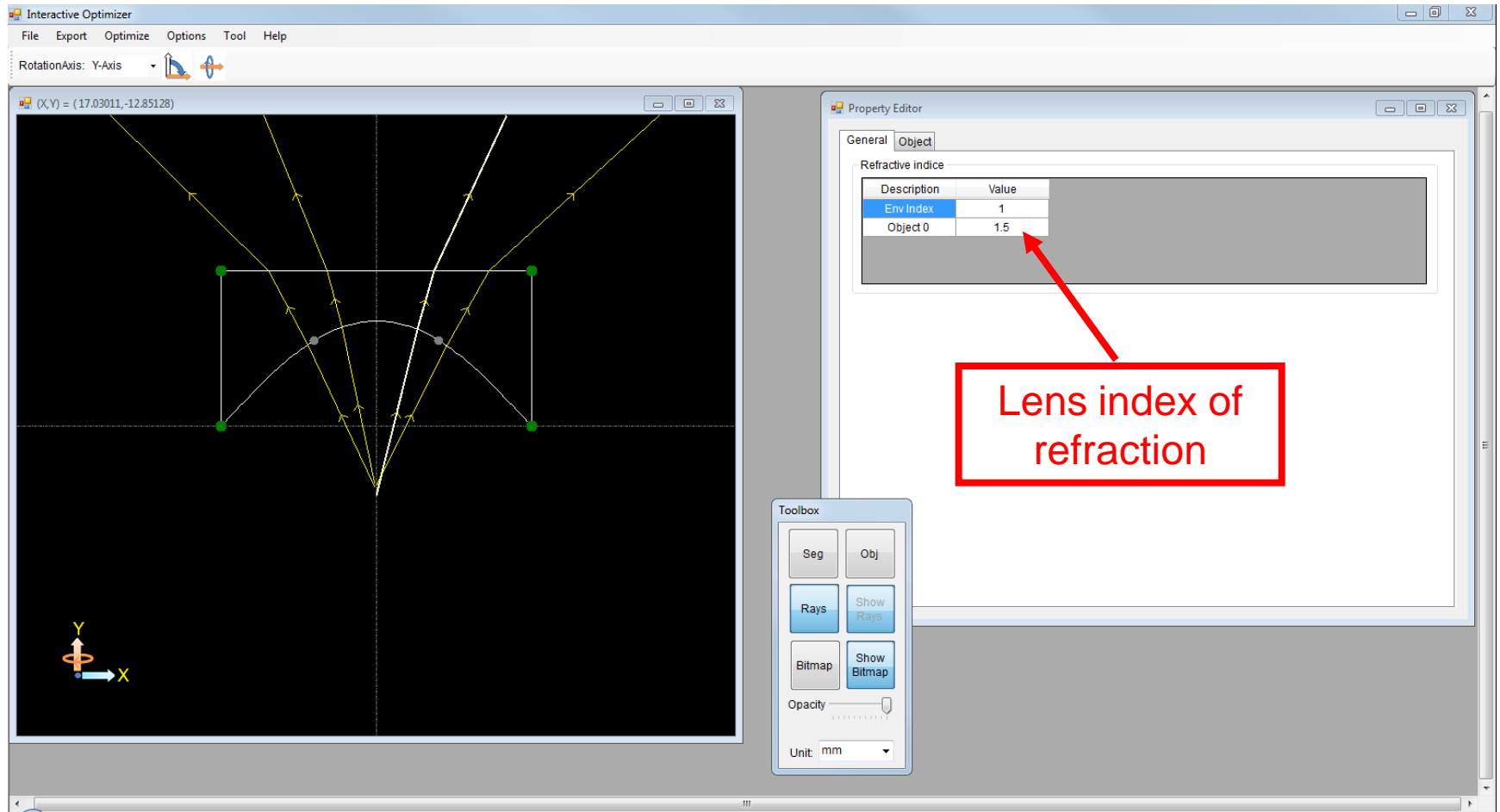
Interactive Optimizer is launched from the Utilities Menu in TracePro

TracePro Interactive Optimizer



Initial windows visible when the optimizer is opened

TracePro Interactive Optimizer



Lens design in the Interactive Optimizer

TracePro Interactive Optimizer

The screenshot displays the TracePro Interactive Optimizer interface. The main window shows a 3D model of a reflector with a blue parabolic curve and yellow rays. The Property Editor window is open, showing the 'Object' tab with the 'Reflector?' checkbox checked. The Toolbox window is also visible, showing the 'Obj' button selected.

1. Select the segment that will be used as the reflector

2. Switch to Object tab

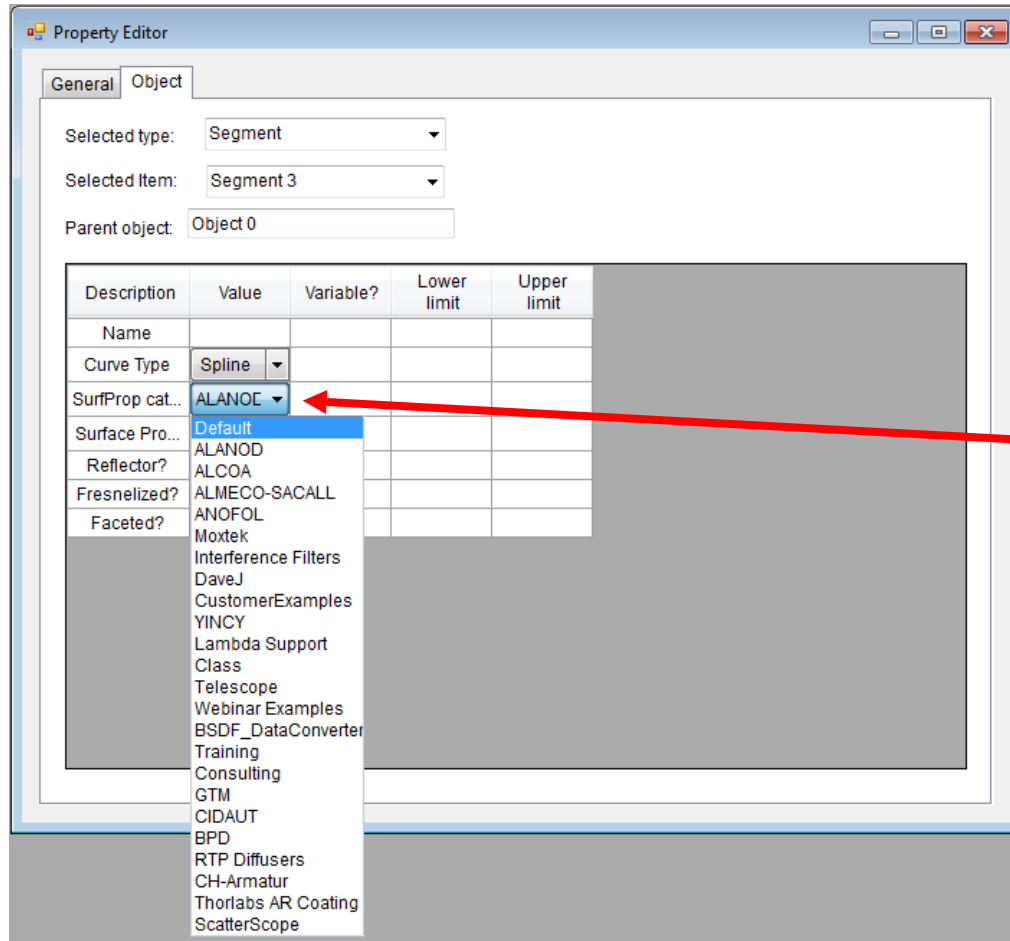
3. Select "Reflector?" to turn the segment into a reflector

4. Rays are now shown as being reflected

Description	Value	Variable?	Lower limit	Upper limit
Name				
Curve Type	Spline			
SurfProp cat...	Default			
Surface Pro...	<Non...			
Reflector?	<input checked="" type="checkbox"/>			
Fresnelized?	<input type="checkbox"/>			
Faceted?	<input type="checkbox"/>			

Reflector design in the Interactive Optimizer

TracePro Interactive Optimizer

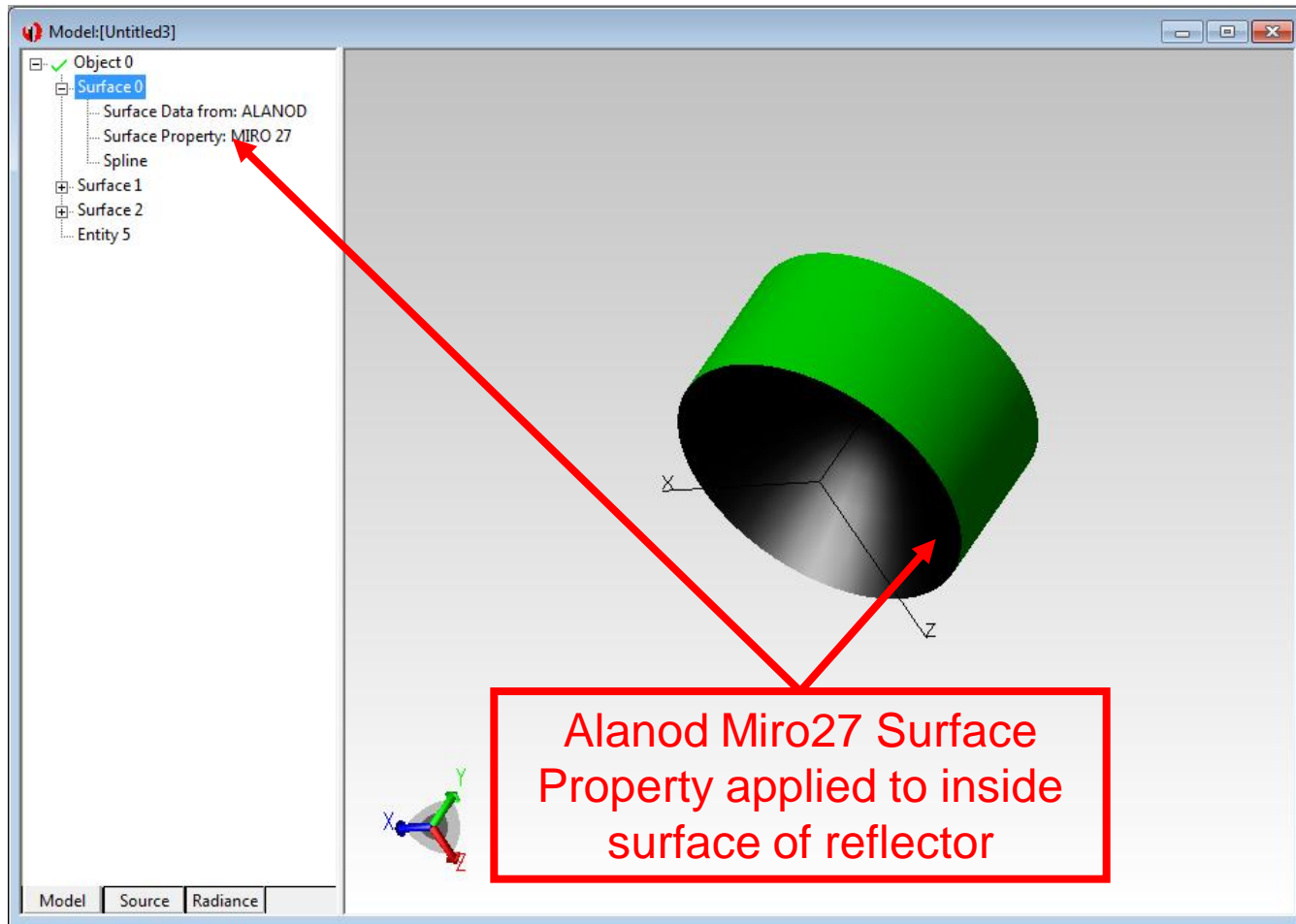


The optimizer uses your existing TracePro property database. Any custom Surface Properties you have defined in TracePro are available in the optimizer.

Select the Surface Property you want to use before exporting the reflector to TracePro.

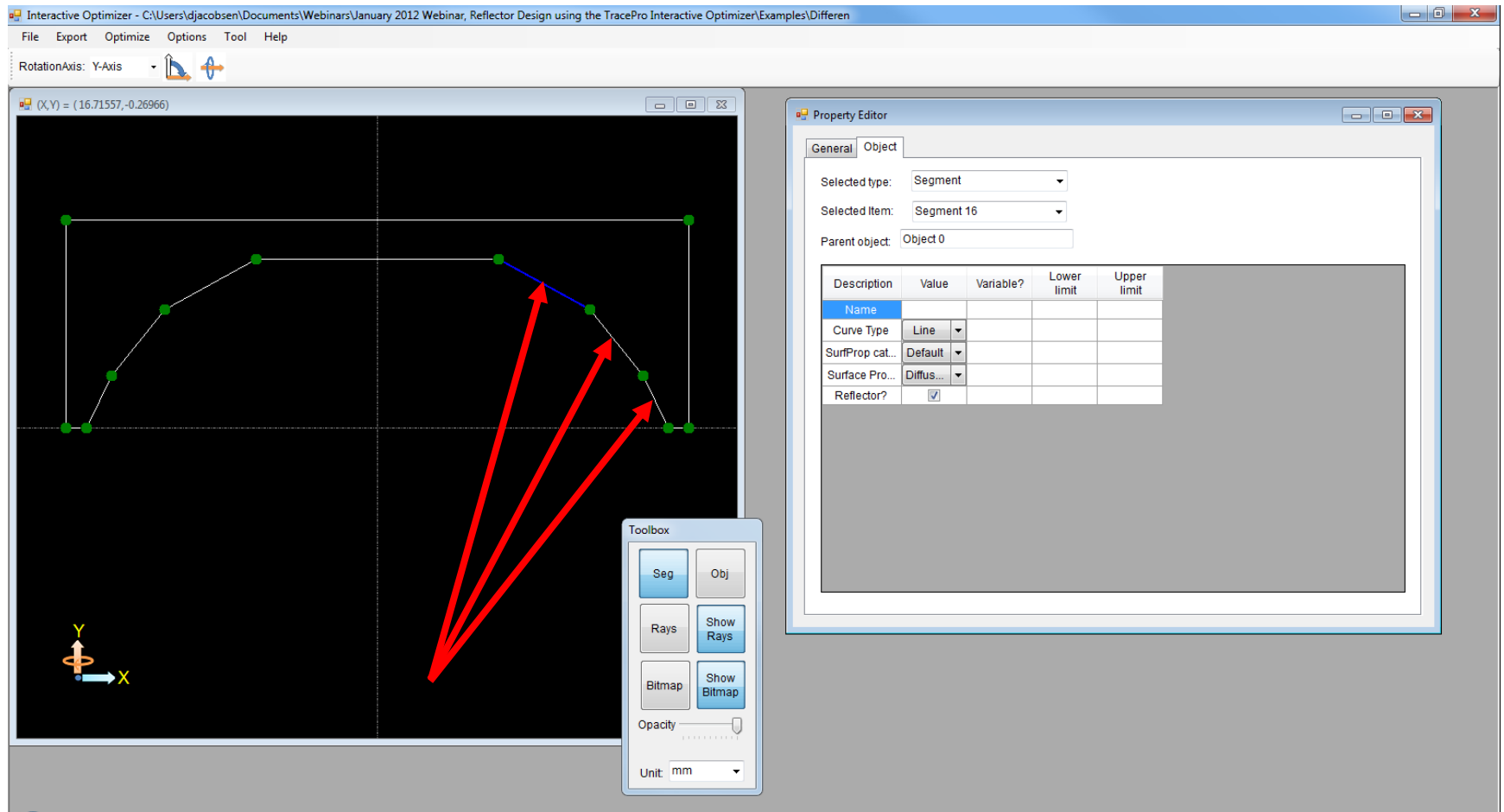
Applying Surface Properties in the Interactive Optimizer

TracePro Interactive Optimizer



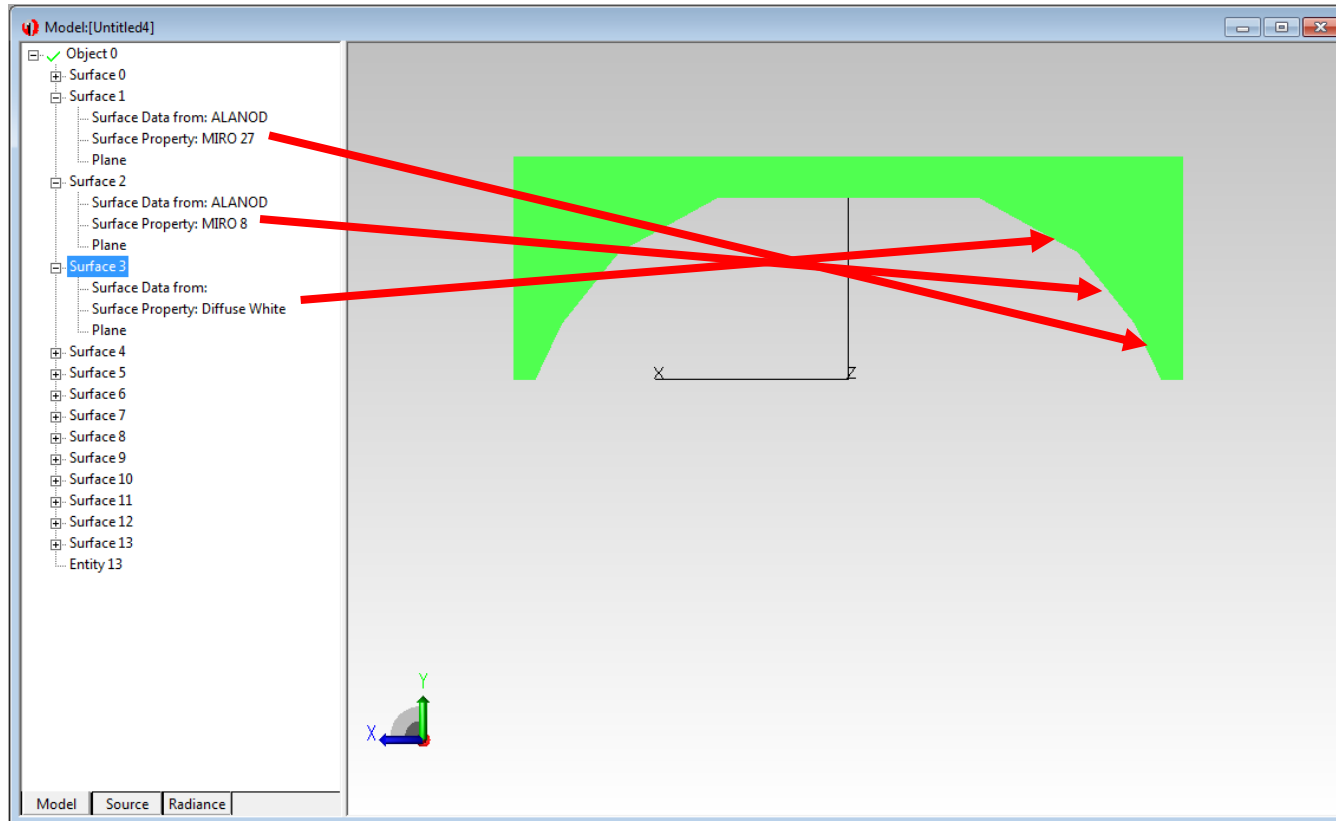
Applying Surface Properties in the Interactive Optimizer

TracePro Interactive Optimizer



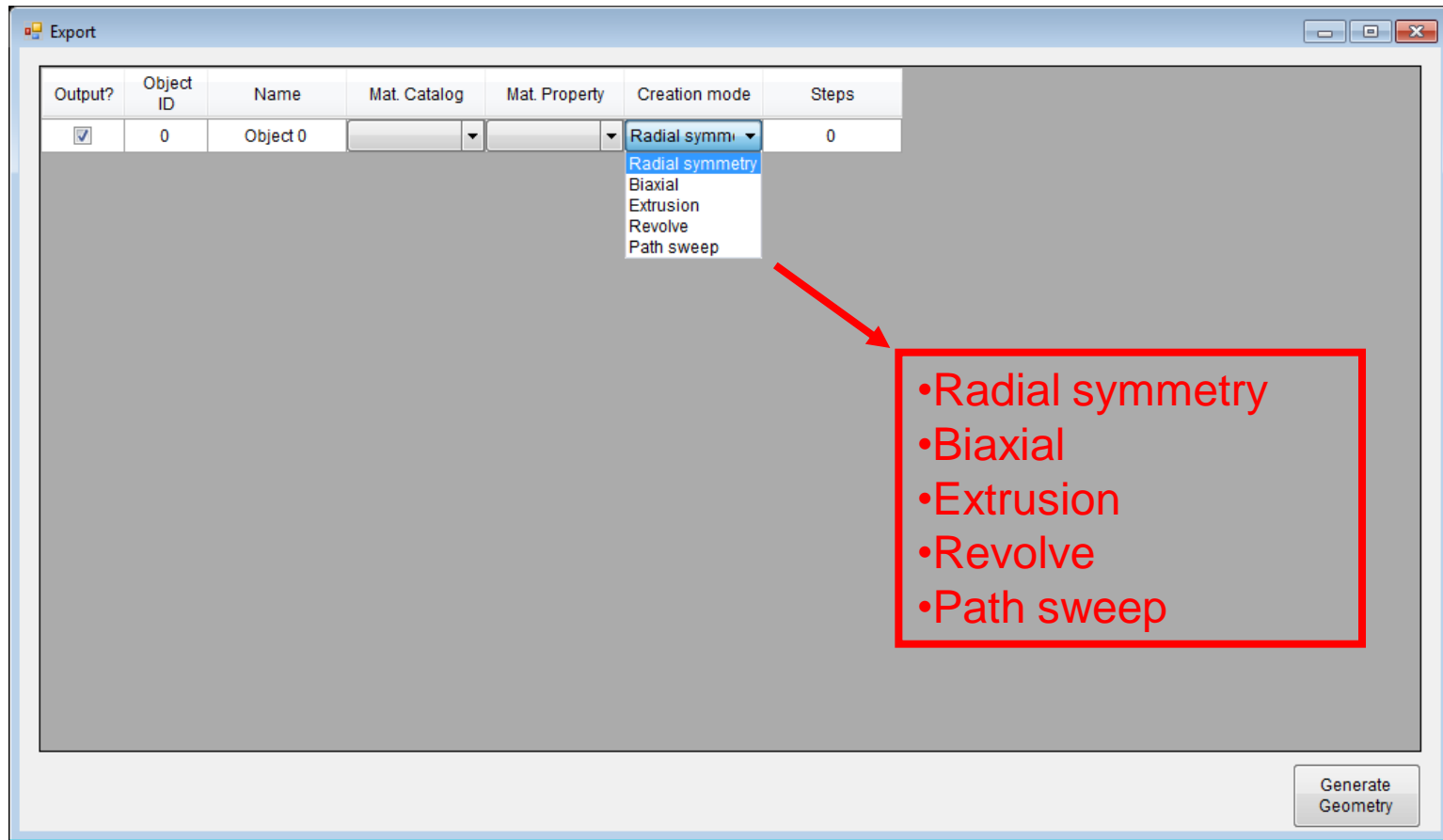
Each segment can have a different Surface Property

TracePro Interactive Optimizer



Different surfaces can have different Surface Properties

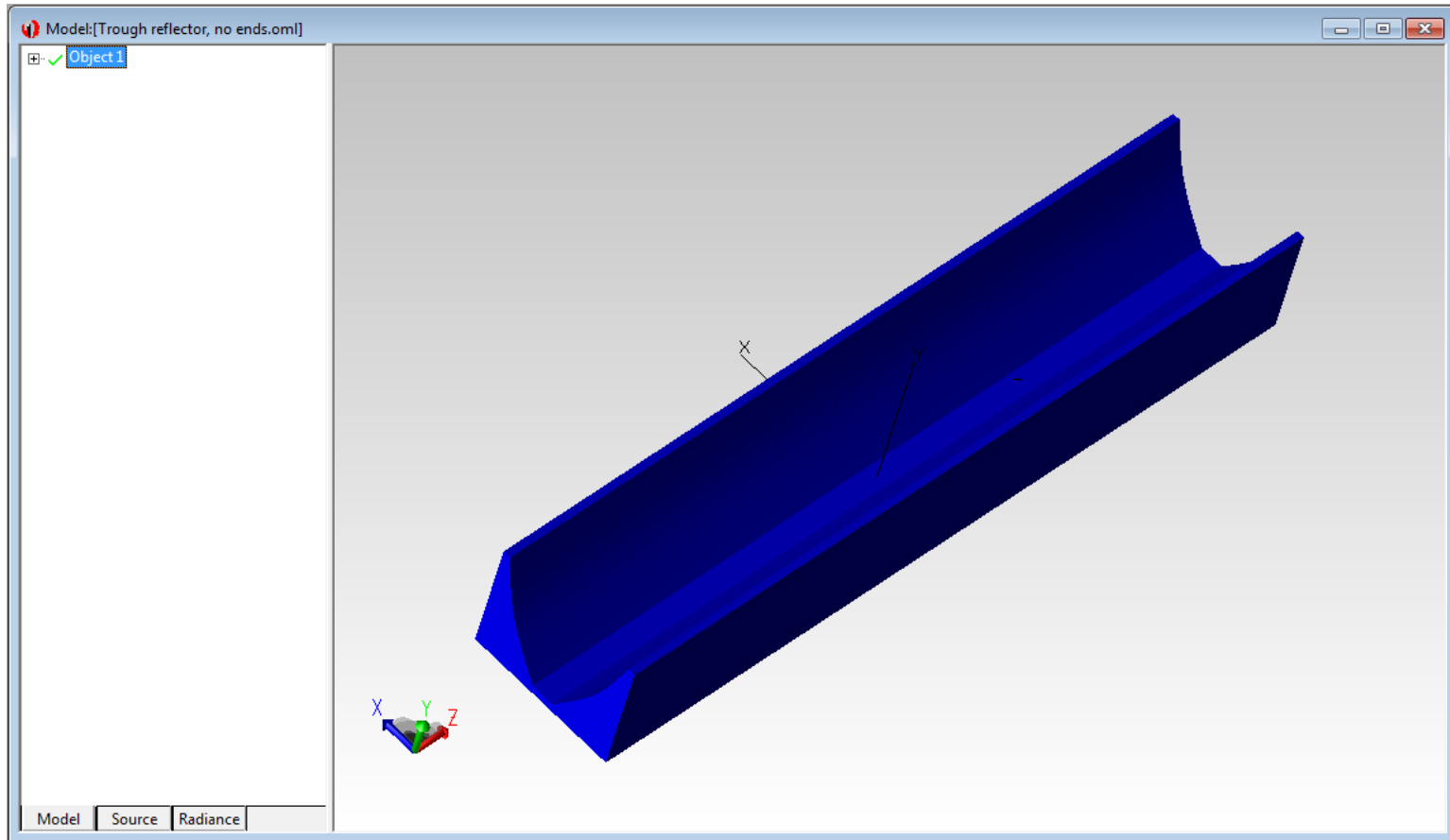
TracePro Interactive Optimizer



Interactive Optimizer geometry creation options

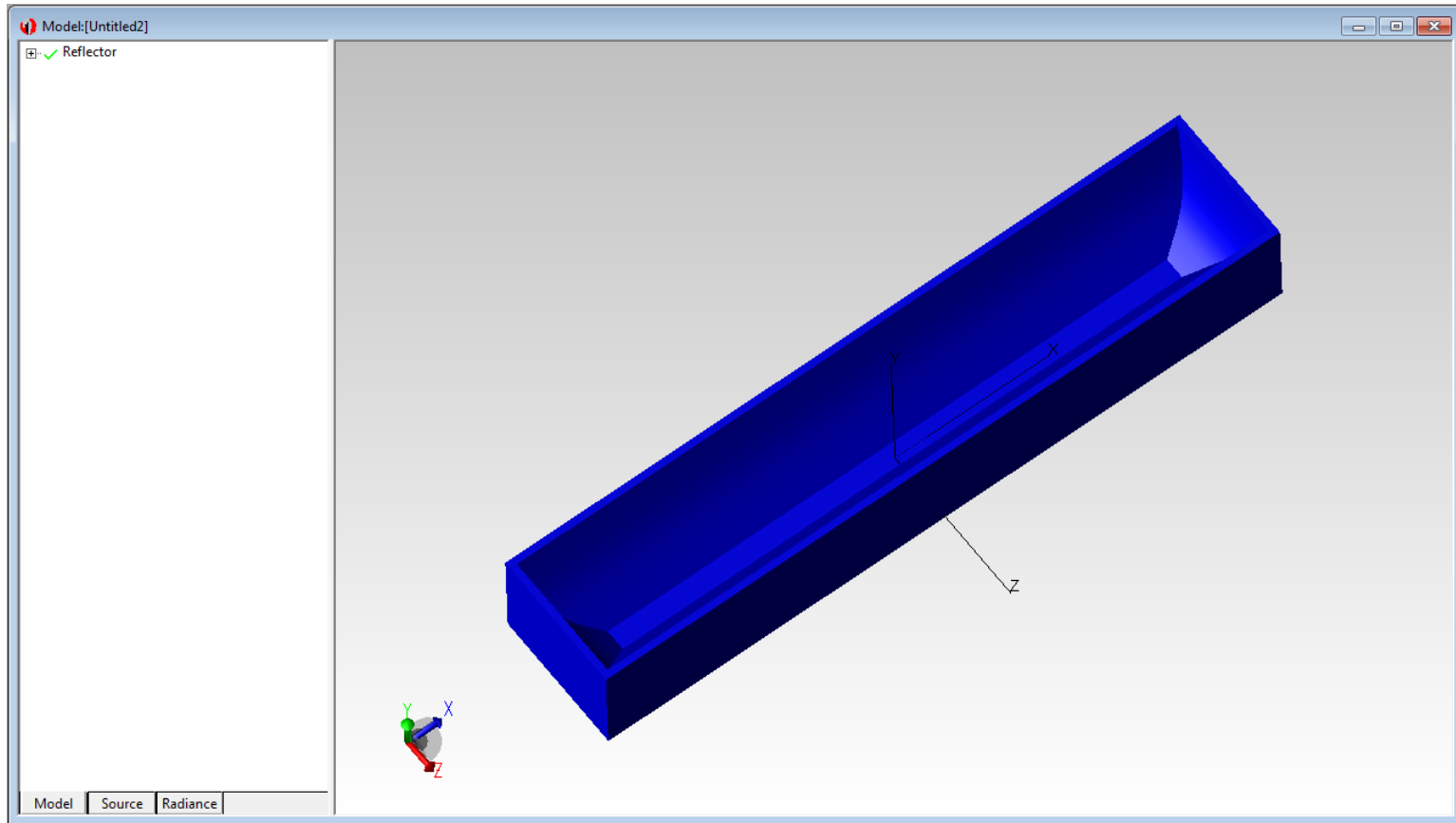
Using the Scheme Macro Language with the Interactive Optimizer

Scheme Macros and the Interactive Optimizer



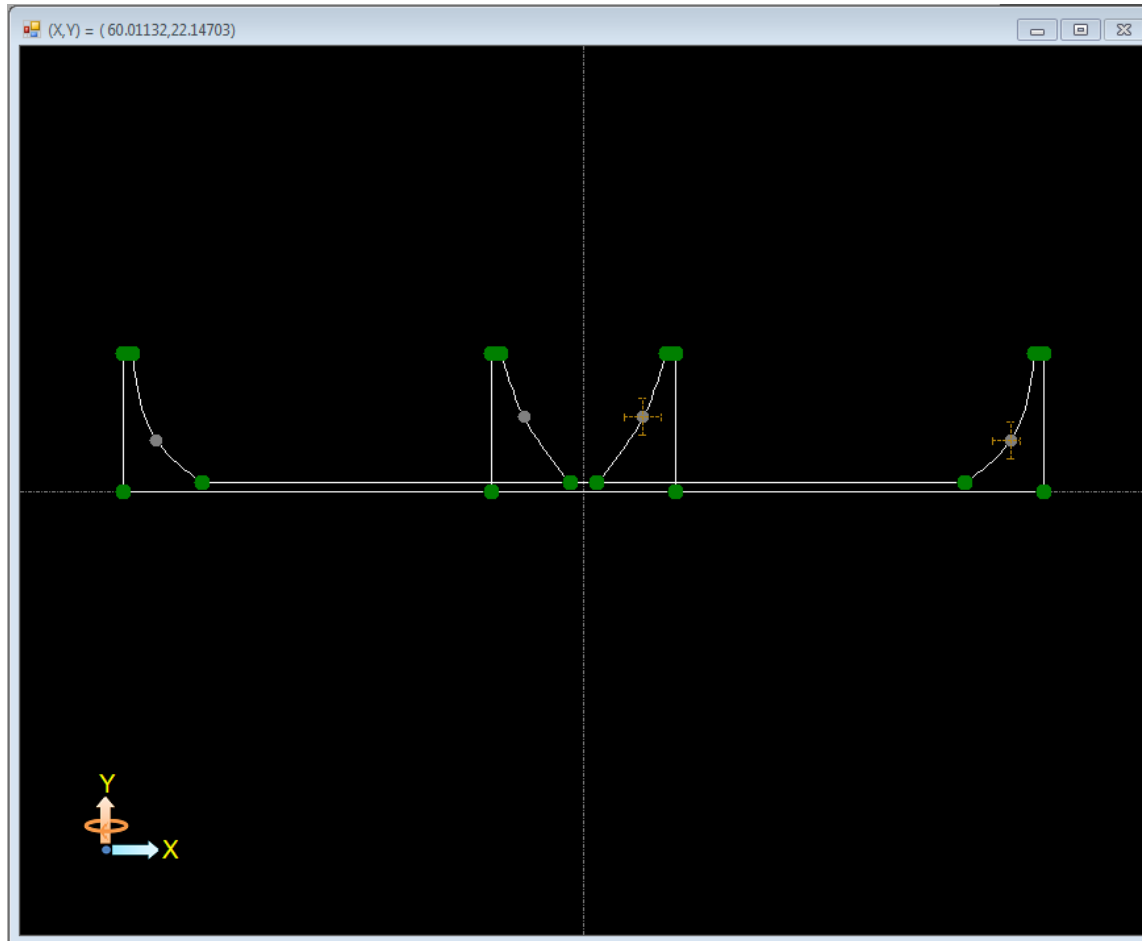
Easy - extruded trough reflector

Scheme Macros and the Interactive Optimizer



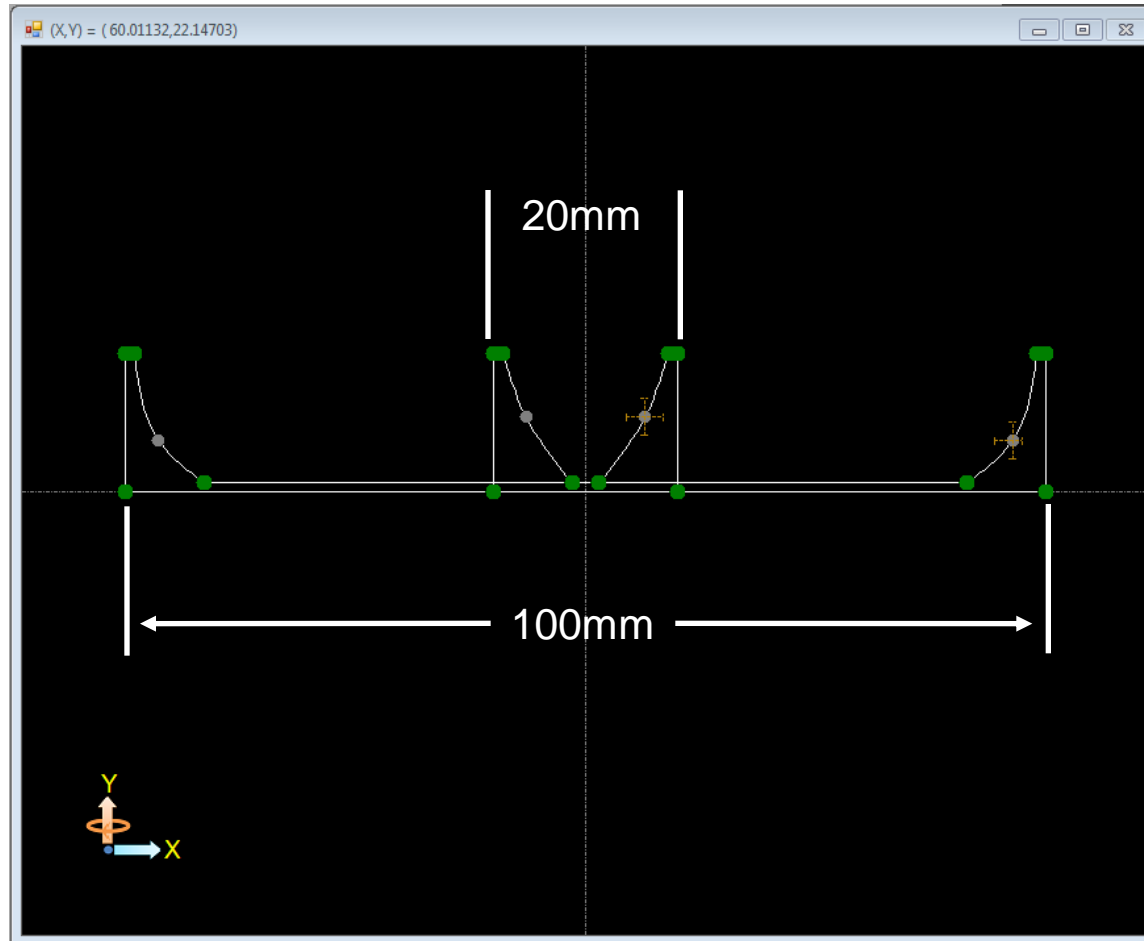
A little more difficult - extruded trough reflector with curved ends

Scheme Macros and the Interactive Optimizer



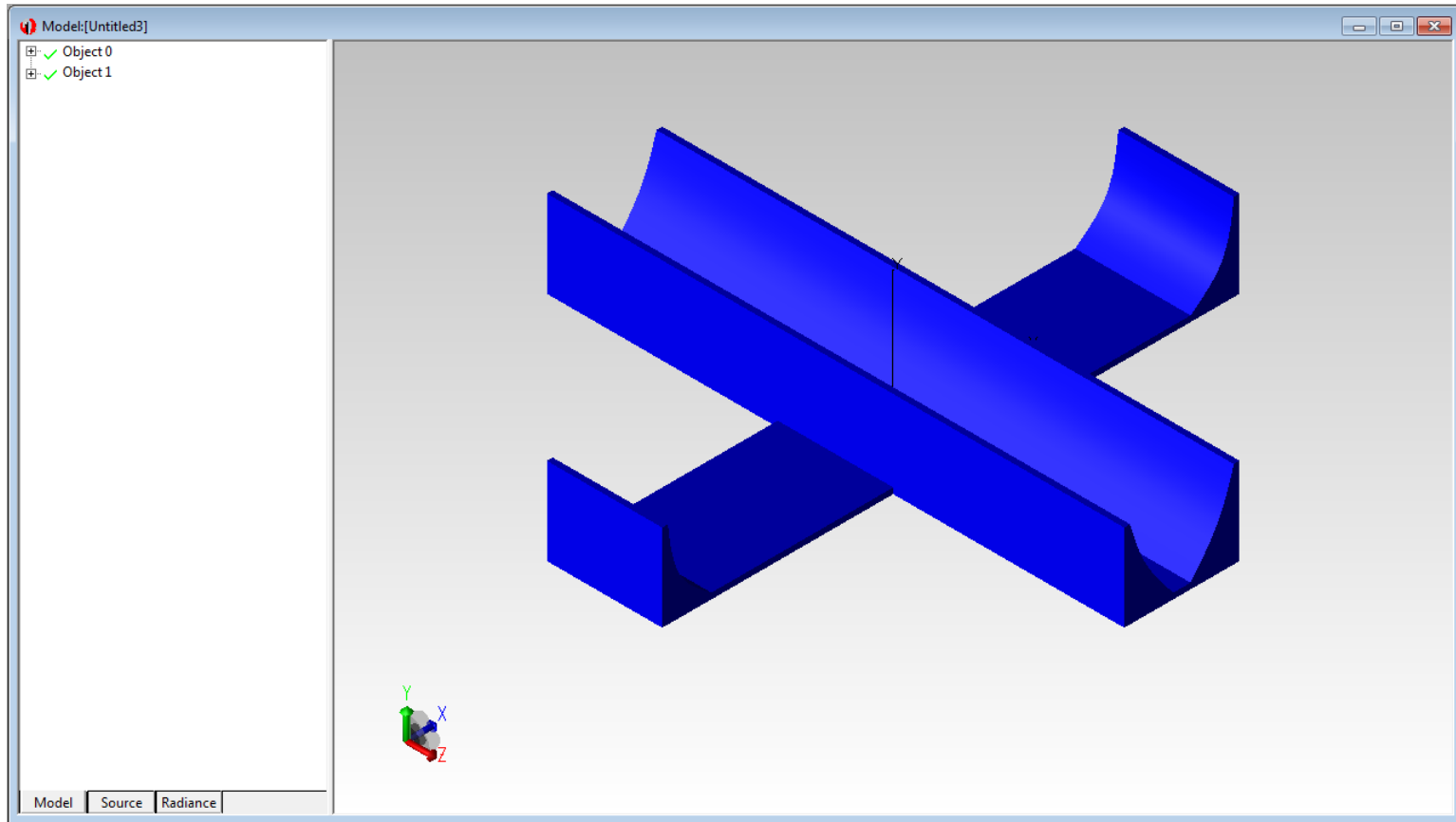
Optimizer Sketch window for extruded trough reflector with curved ends

Scheme Macros and the Interactive Optimizer



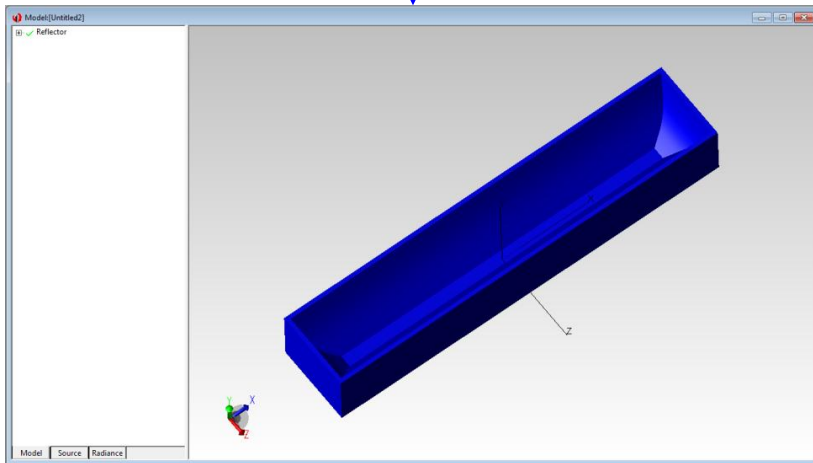
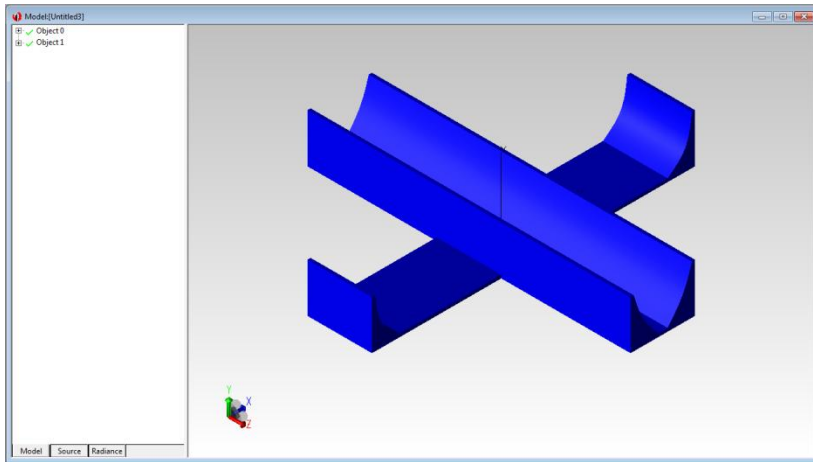
Optimizer Sketch window for extruded trough reflector with curved ends

Scheme Macros and the Interactive Optimizer



Initial results after exporting the 2 profiles from the optimizer as extrusions

Scheme Macros and the Interactive Optimizer



To make the final trough reflector we need to write a Scheme macro to:

1. Rotate the long trough segment 90-degrees
2. Unite the 2 trough segments into a single object
3. Apply a Surface Property to the reflector to model the reflective finish

Scheme Macros and the Interactive Optimizer

Optimization

Save path: C:\Webinars\Webinar Examples

File prefix: test

Variables

Object / Var name	ID	Type	Value	Low limit	Hi limit
Obj 1/ Crv 28	0	Pos-X	6.4694...	2	2
Obj 1/ Crv 28	0	Pos-Y	8.1200...	2	2
Obj 0/ Crv 24	0	Pos-X	46.379...	2	1
Obj 0/ Crv 24	0	Pos-Y	5.5134...	2	2

Operands

Type	Opt.	Wgt.	Surface	Location Ray type	Target
Can Profile	Similarity	1.0		Exiti...	{{(-180,-60,-...
Can Profile	Similarity	1.0		Exiti...	{{(-180,-30,-...

Objects

Output?	Object ID	Name	Mat. Catalog	Mat. Property	Geo. type	Steps	After-scheme
		Pre-processor					
<input checked="" type="checkbox"/>	0	Object 0	None		Extrusion	20	
<input checked="" type="checkbox"/>	1	Reflector	None		Extrusion	100	grotate("Reflector", pos(...

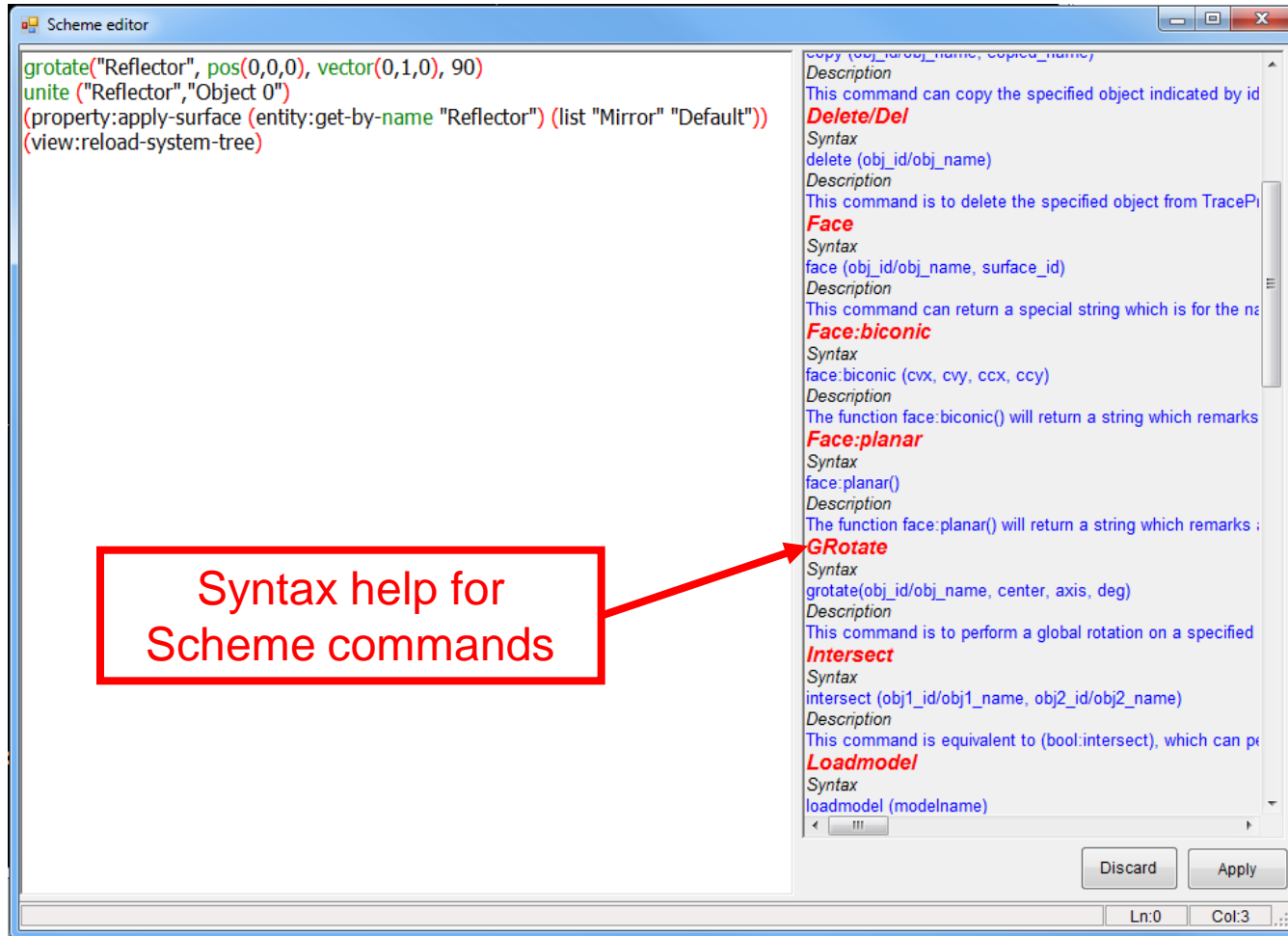
Note the Extrusion lengths

Double click in the "After-scheme" box to open the macro editor

Start

Adding a Scheme macro in the Optimization window

Scheme Macros and the Interactive Optimizer



Adding a Scheme macro

Scheme Macros and the Interactive Optimizer

```
Scheme editor  
grotate("Reflector", pos(0,0,0), vector(0,1,0), 90)  
unite ("Reflector","Object 0")  
(property:apply-surface (entity:get-by-name "Reflector") (list "Mirror" "Default"))  
(view:reload-system-tree)
```

Scheme macro to:

1. Rotate the long trough segment 90-degrees
2. Unite the 2 trough segments into a single object
3. Apply a Surface Property to the object to model the reflective finish
4. Update the System Tree

Scheme Macros and the Interactive Optimizer

The screenshot displays the Optimization software interface with the following components:

- Save path:** C:\Webinars\Webinar Examples
- File prefix:** test
- Variables Table:**

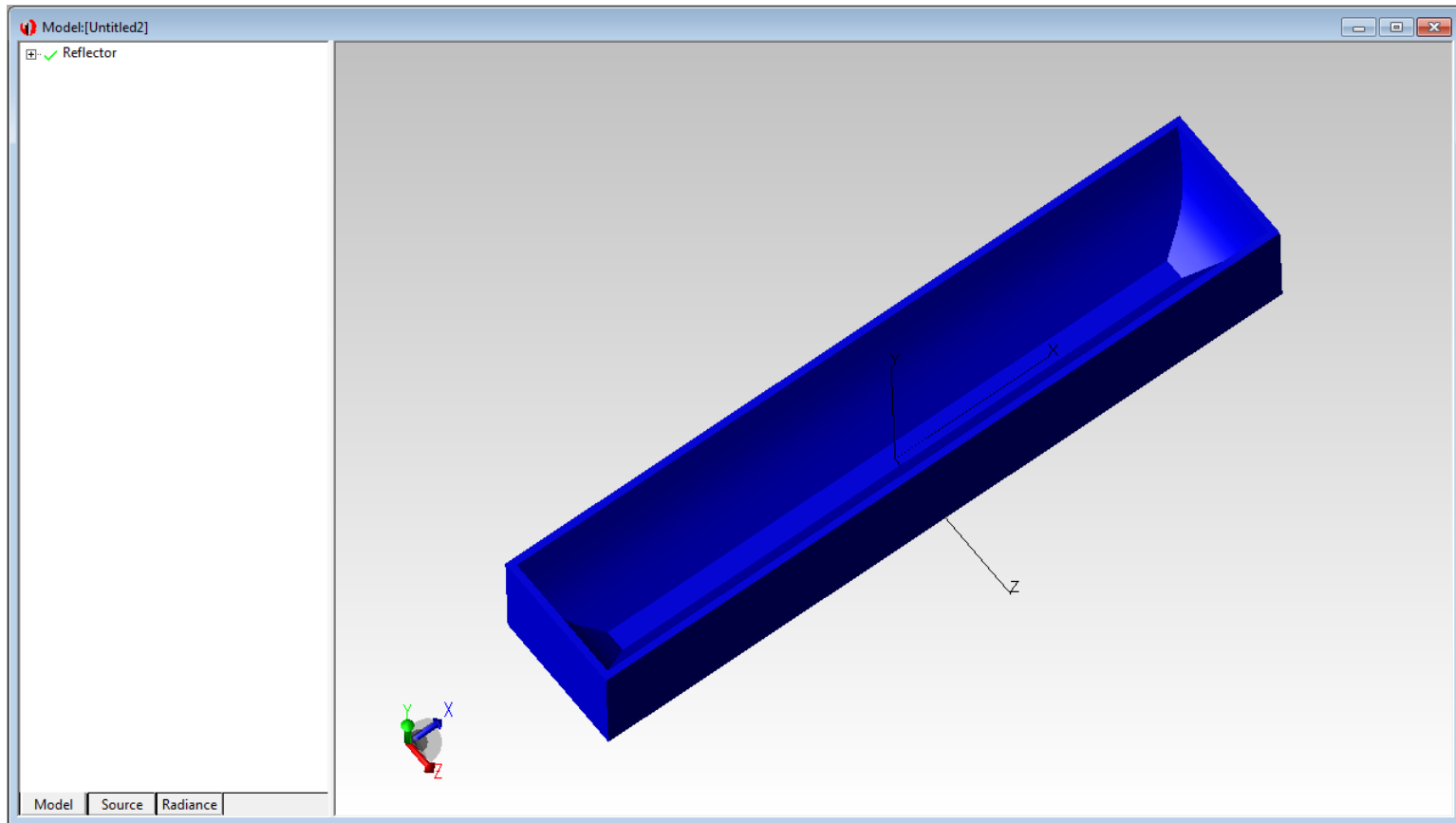
Object / Var name	ID	Type	Value	Low limit	Hi limit
Obj 1/ Crv 28	0	Pos-X	6.4694...	2	2
Obj 1/ Crv 28	0	Pos-Y	8.1200...	2	2
Obj 0/ Crv 24	0	Pos-X	46.379...	2	1
Obj 0/ Crv 24	0	Pos-Y	5.5134...	2	2
- Operands Table:**

Type	Opt.	Wgt.	Surface	Location Ray type	Target
Can Profile	Similarity	1.0		Exiti...	{{(-180,-60,-...
Can Profile	Similarity	1.0		Exiti...	{{(-180,-30,-...
- Objects Table:**

Output?	Object ID	Name	Mat. Catalog	Mat. Property	Geo. type	Steps	After-scheme
		Pre-processor					
<input checked="" type="checkbox"/>	0	Object 0	None		Extrusion	20	
<input checked="" type="checkbox"/>	1	Reflector	None		Extrusion	100	grotate("Reflector", pos(...
- Context Menu:** A right-click menu is open over the "After-scheme" cell of the "Reflector" object, showing options: "Execute cmd", "Create model & run cmd", and "Create model & run cmd & Raytrace".

Right click in the "After-scheme" box and choose "Create model & run cmd" to export the model and check the results in TracePro

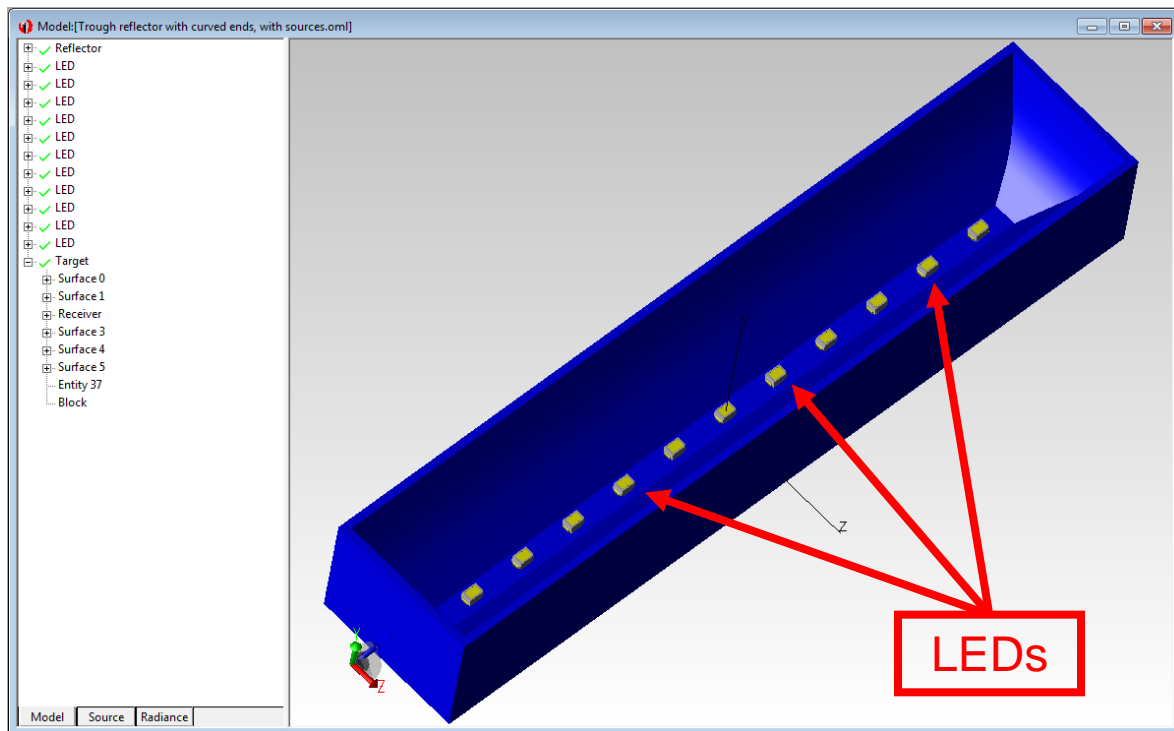
Scheme Macros and the Interactive Optimizer



Extruded trough reflector with curved ends in TracePro

Defining Sources and Targets

Defining Sources and Targets



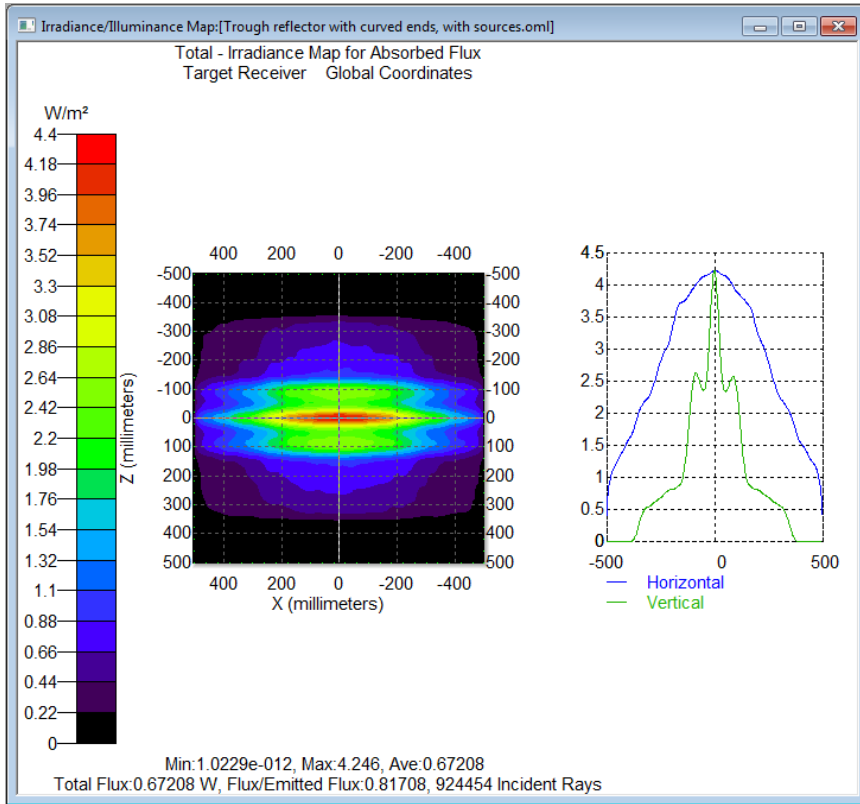
A copy of the reflector can be exported from the optimizer and used in TracePro to set-up the sources and the targets, if required

The Interactive Optimizer will use the sources defined in the TracePro model during the optimization.

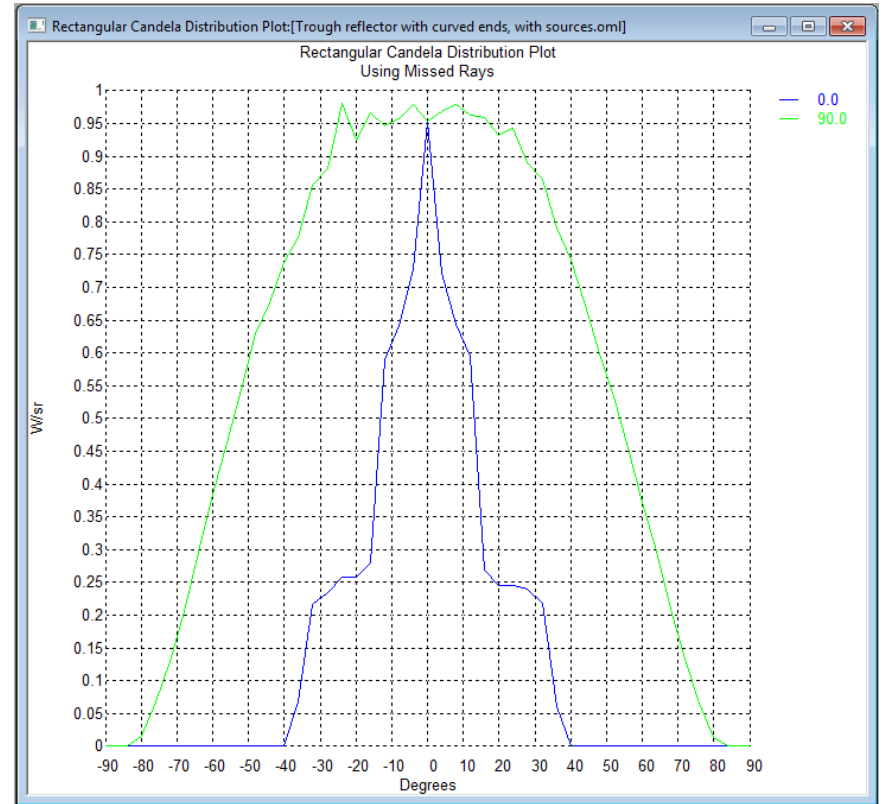
Any type of source can be used: Grid, File, Surface, or a combination.

11 LEDs used as sources.

Defining Sources and Targets



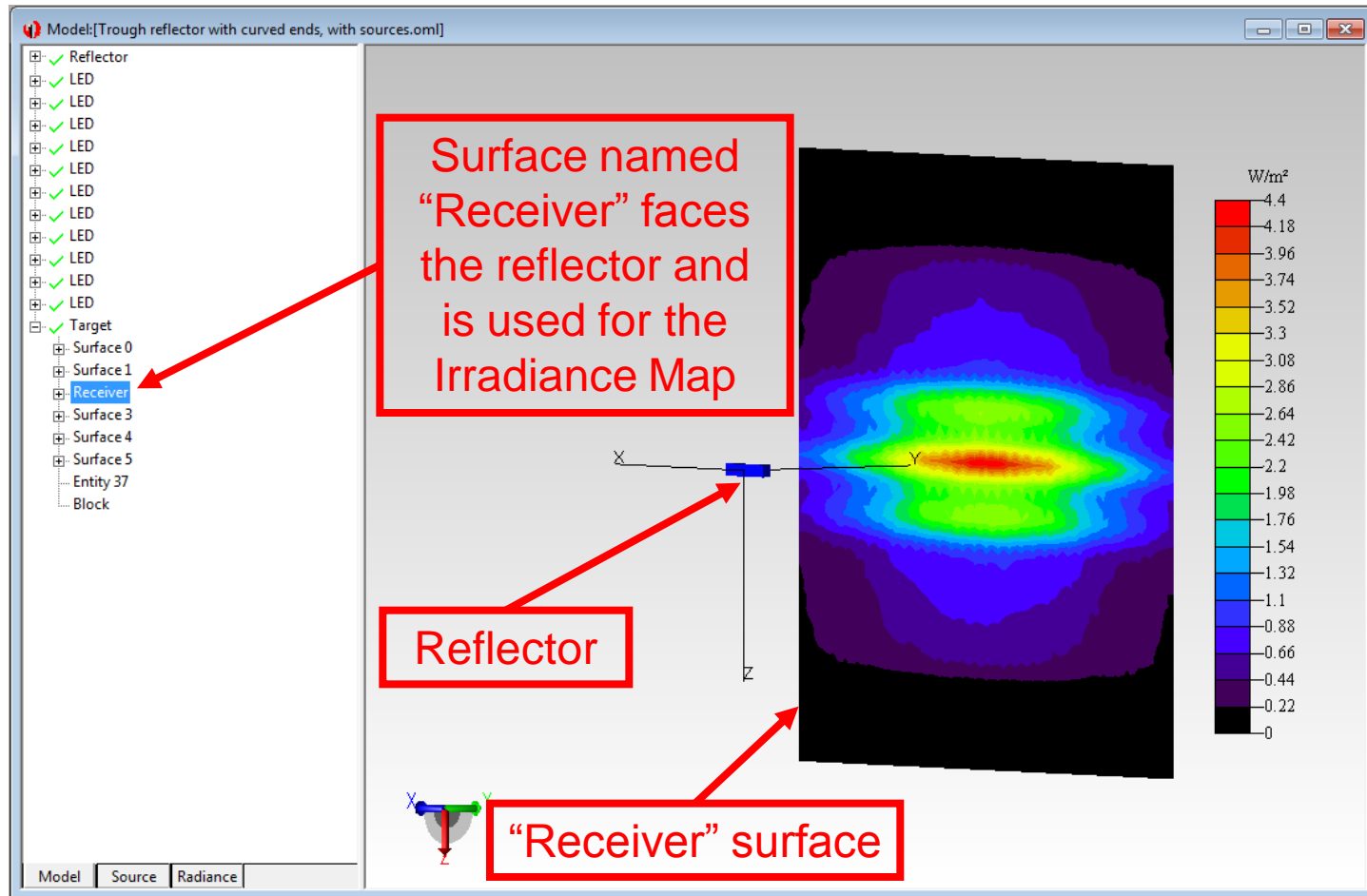
Irradiance Map



Candela Plot

Two common optimization targets are Irradiance and Candela Profiles

Defining Sources and Targets



If you are using an Irradiance Profile as the optimization target, you must have a surface in TracePro for the Irradiance Map.

Defining Sources and Targets

The name of the Surface in the TracePro model for the Irradiance Profile is entered here

File prefix: test

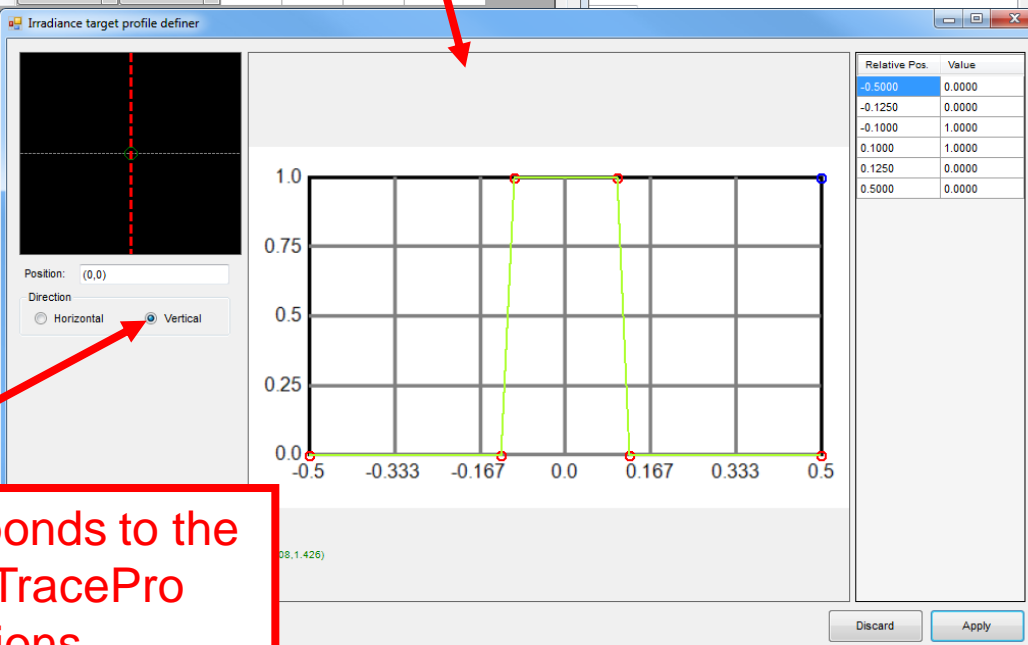
Variables

Object / Var name	ID	Type	Value	Low limit	Hi limit
Obj 1/ Crv 28	0	Pos-X	6.4694...	2	2
Obj 1/ Crv 28	0	Pos-Y	8.1200...	2	2
Obj 0/ Crv 24	0	Pos-X	46.379...	2	1
Obj 0/ Crv 24	0	Pos-Y	5.5134...	2	2

Objects

Output?	Object ID	Name	Mat. Catalog	Mat. Property	Geo. t
<input type="checkbox"/>		Pre-processor			
<input checked="" type="checkbox"/>	0	Object 0	None		Extrusion
<input checked="" type="checkbox"/>	1	Reflector	None		Extrusion

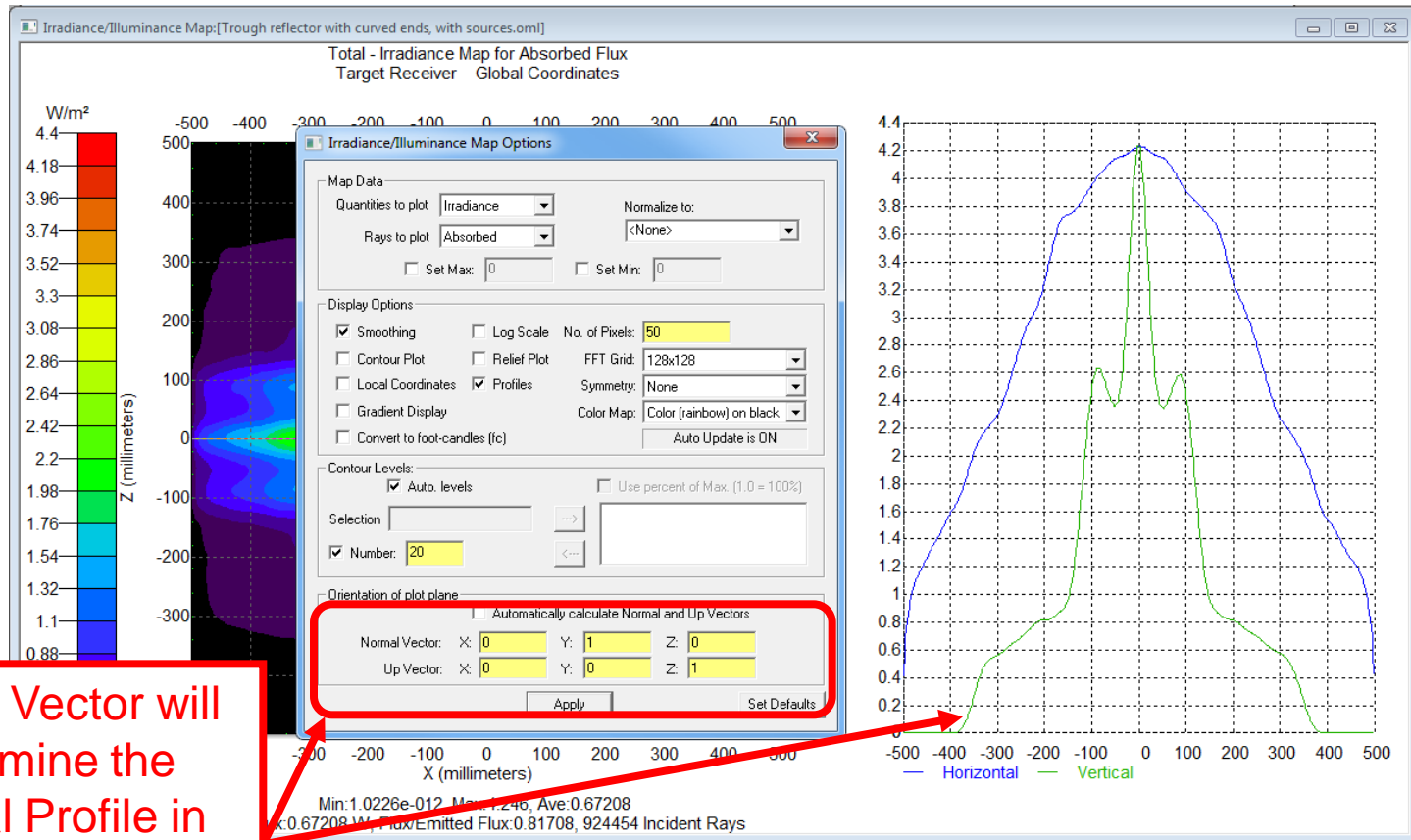
Type	Opt	Surface	Location Ray type	Target
Irr Profile	Similarity	Receiver		{(0,0,1,1,0,0)}
Irr Profile	Similarity	Receiver		{(0,0,1,0.5...



The Vertical Profile corresponds to the Up Vector setting in the TracePro Irradiance Map Options

Different Irradiance Profile optimization targets can be defined for the horizontal and vertical axes

Defining Sources and Targets



The Up Vector will determine the Vertical Profile in the optimizer Irradiance Profile operand

Defining Sources and Targets

The name of the Surface in the TracePro model for the Irradiance Profile is entered here

The screenshot shows the TracePro interface with the 'Irradiance target profile definier' dialog box open. The dialog has a 'Position' field set to '(0,0)' and 'Direction' set to 'Horizontal'. A graph shows a trapezoidal irradiance profile with a peak of 1.0. A table on the right lists relative positions and values.

Relative Pos.	Value
-0.5000	0.0000
-0.3500	1.0000
0.3500	1.0000
0.5000	0.0000

Different Irradiance Profile optimization targets can be defined for the horizontal and vertical axes

Defining Sources and Targets

Save path: C:\Webinars\Webinar Examples

File prefix: test

Variables

Object / Var name	ID	Type	Value	Low limit	Hi limit
Obj 1/ Crv 28	0	Pos-X	6.4694...	2	2
Obj 1/ Crv 28	0	Pos-Y	8.1200...	2	2
Obj 0/ Crv 24	0	Pos-X	46.379...	2	1
Obj 0/ Crv 24	0	Pos-Y	5.5134...	2	2

Operands

Type	Opt.	Wgt.	Surface	Location Ray type	Target
Can Profile	Similarity	1.0		Exiti...	{{(-180,-60,-...
Can Profile	Similarity	1.0		Exiting	{{(-180,-30,-...

Exiting ray
Incident ray

After-scheme

grotate("Reflector", pos(...

Start

For the Candela Profile operand, if a surface in TracePro is not used as a target, select "Exiting ray". If a surface is to be used as the target, select "Incident ray" and enter the name of the surface in the Surface column.

When optimizing to a Candela Profile operand, a surface in TracePro does not have to be used as a target

Defining Sources and Targets

The screenshot shows the TracePro Interactive Optimizer interface. The main window displays optimization variables and operands. A red box highlights the target value $\{(-180,-30,-...)$ in the Operands table. A red arrow points from this box to the Candela target definer dialog. The dialog shows a profile chooser with a circular plot and a rectangular plot. A red box highlights the 'Selected azimuth: 0' field. A red arrow points from this box to a text box on the left.

Optimization Variables Table:

Object / Var name	ID	Type	Value	Low limit	Hi limit
Obj 1/ Crv 28	0	Pos-X	6.4694...	2	2
Obj 1/ Crv 28	0	Pos-Y	8.1200...	2	2
Obj 0/ Crv 24	0	Pos-X	46.379...	2	2
Obj 0/ Crv 24	0	Pos-Y	5.5134...	2	2

Operands Table:

Type	Opt.	Wgt.	Surface	Location Ray type	Target
Can Profile	Similarity	1.0		Extr...	$\{(-180,-30,-...)$
Can Profile	Similarity	1.0		Extr...	$\{(-180,-30,-...)$

Candela target definer Dialog:

Profile chooser: Symmetric input

Selected azimuth: 0

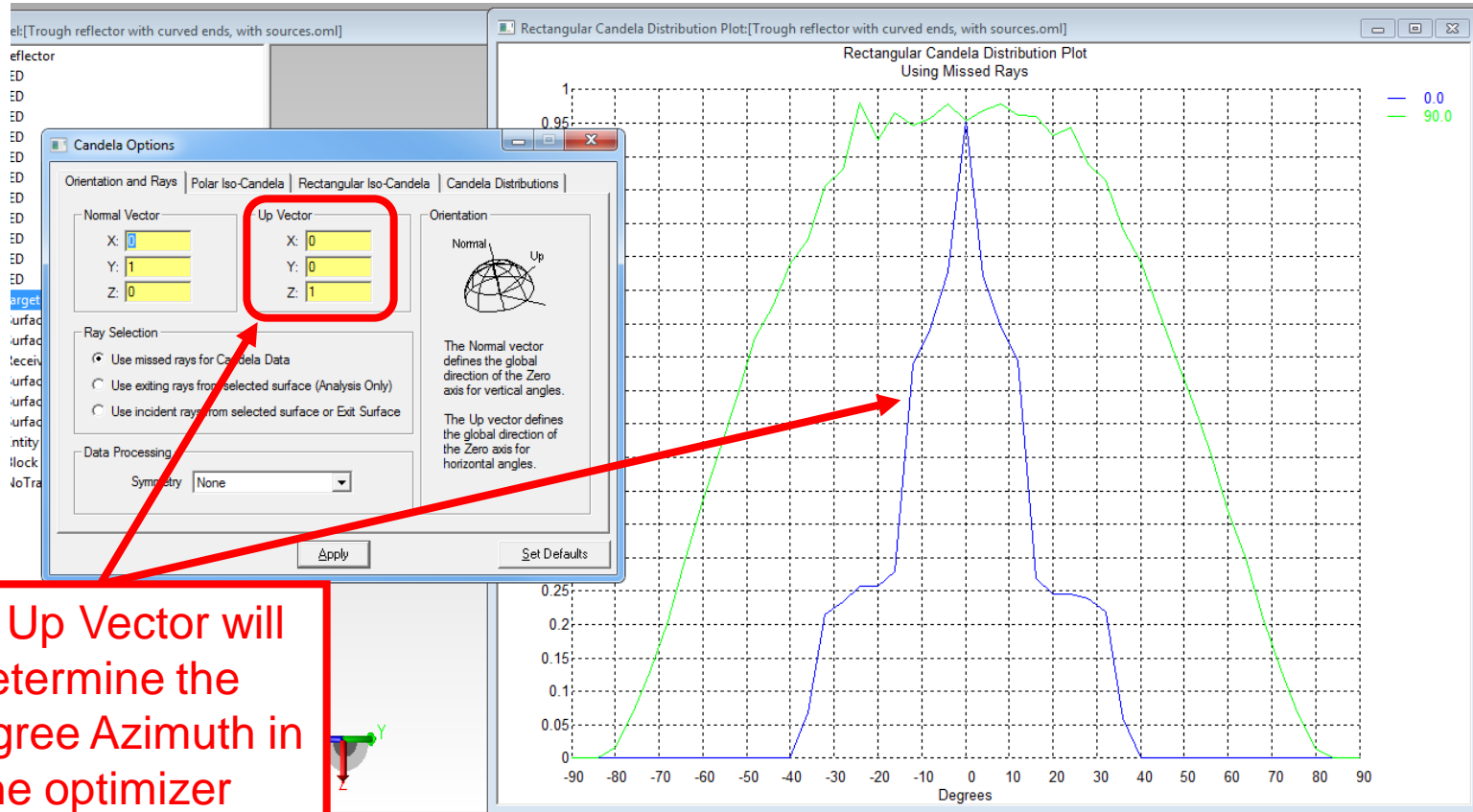
Plot type: Rectangular Polar

Angle	Value
-180.0000	0.0000
-30.0000	0.0000
-20.0000	0.5000
-15.0000	1.0000
15.0000	1.0000
20.0000	0.5000
30.0000	0.0000
180.0000	0.0000

The 0-degree Azimuth corresponds to the Up Vector setting in the TracePro Candela Plot Options

Different Candela Profile optimization targets can be defined for different axes

Defining Sources and Targets



The Up Vector will determine the 0-degree Azimuth in the optimizer Candela Profile operand

Defining Sources and Targets

The screenshot shows the TracePro Interactive Optimizer interface. The main window displays optimization variables and operands. A red box highlights a target value in the Operands table, which is linked to a 'Candela target definer' dialog box. The dialog box shows a circular profile with a selected azimuth of 270 degrees and a corresponding graph of the Candela profile. A red callout box points to the graph with the following text:

Second Candela Profile operand defined along the 90-270-degree Azimuth

Object / Var name	ID	Type	Value	Low limit	Hi limit
Obj 1/ Crv 28	0	Pos-X	6.4694...	2	2
Obj 1/ Crv 28	0	Pos-Y	8.1200...	2	2
Obj 0/ Crv 24	0	Pos-X	46.379...	2	2
Obj 0/ Crv 24	0	Pos-Y	5.5134...	2	2

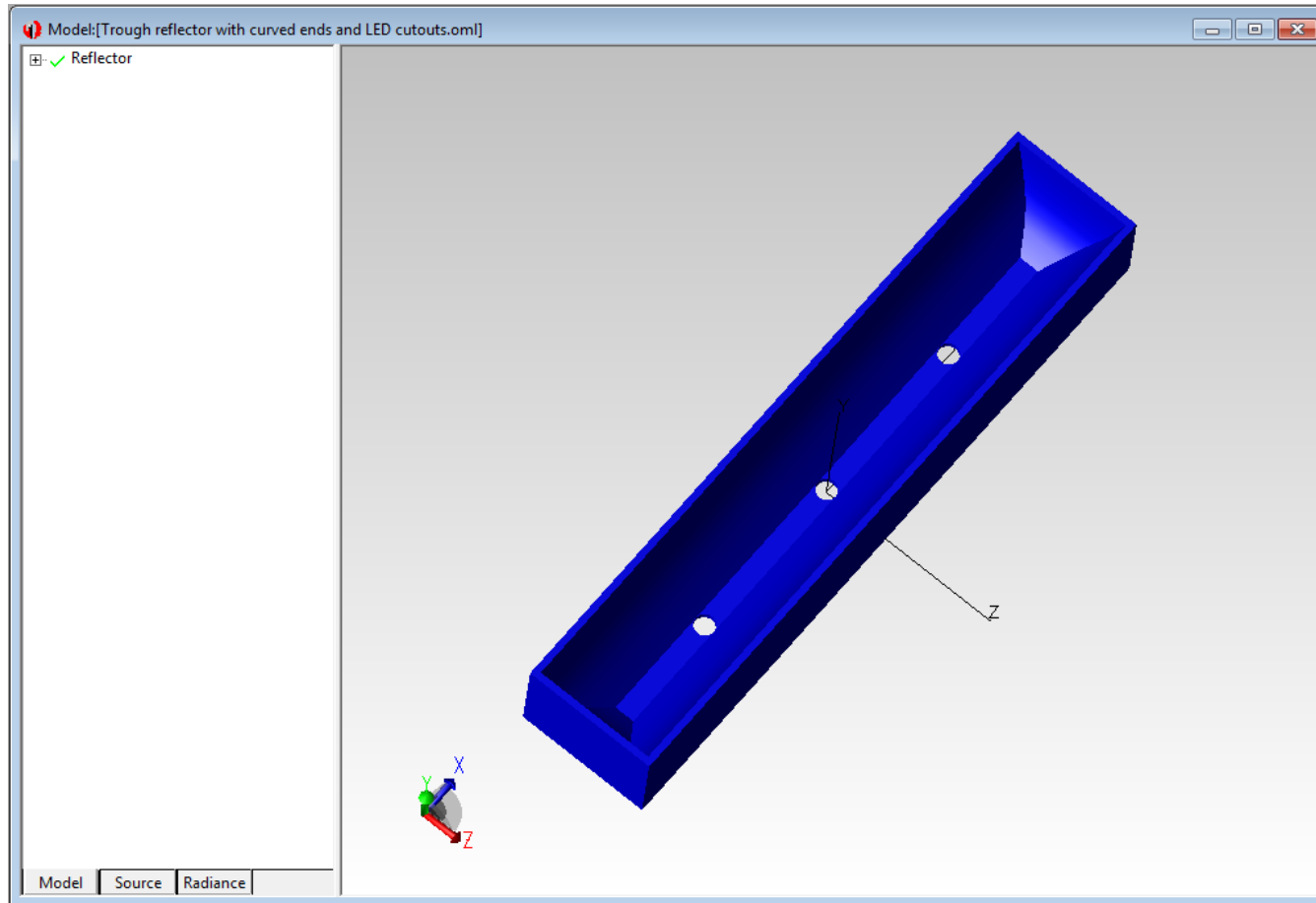
Type	Opt.	Wgt.	Surface	Location Ray type	Target
Can Profile	Similarity	1.0		Exit...	{{(-180,-75...
Can Profile	Similarity	1.0		Exit...	{{(-180,-75...

Angle	Value
-180.0000	0.0000
-75.0000	0.1000
-45.0000	0.5000
-30.0000	1.0000
30.0000	1.0000
45.0000	0.5000
75.0000	0.1000
180.0000	0.0000

Different Candela Profile optimization targets can be defined for different axes

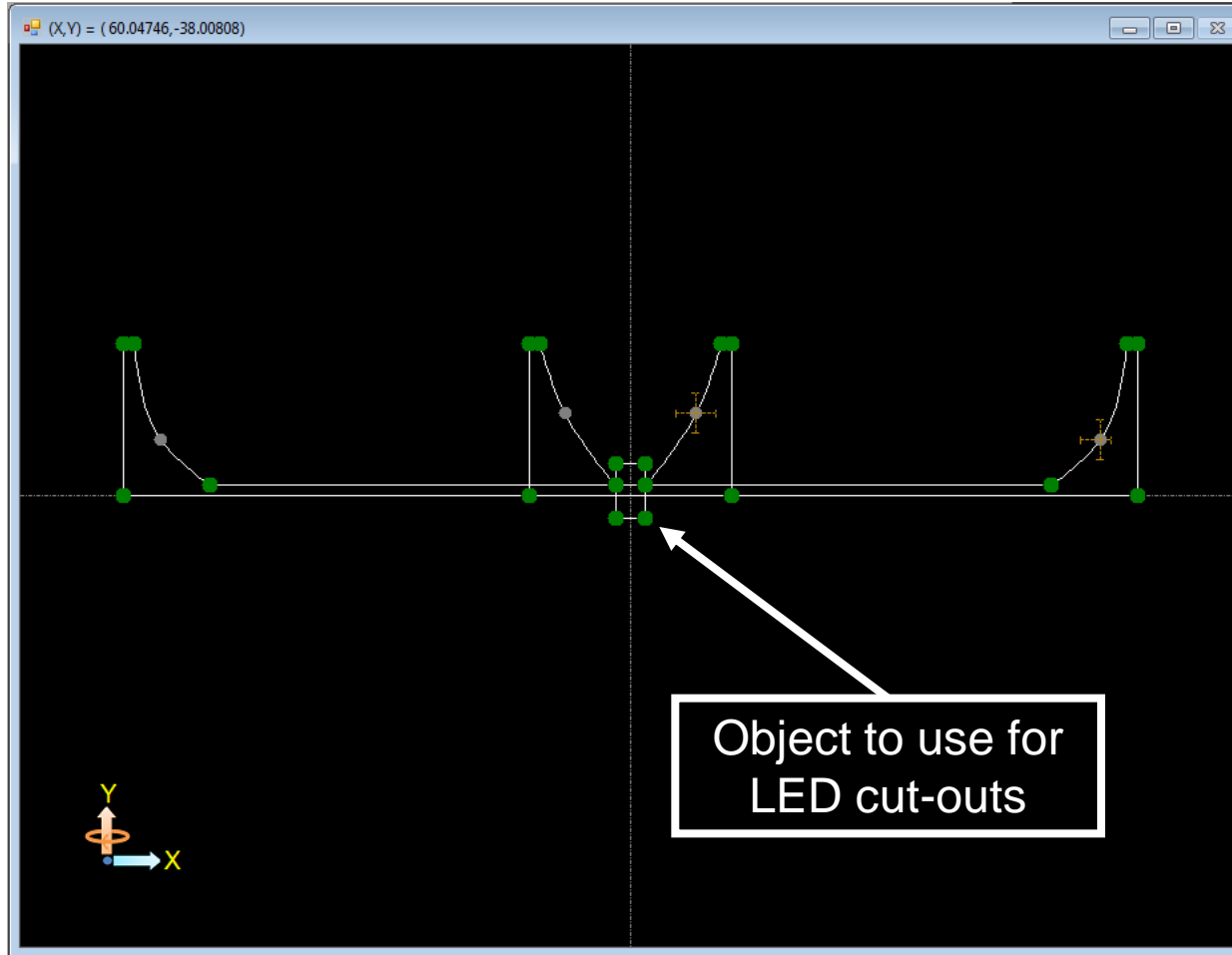
Examples

Examples



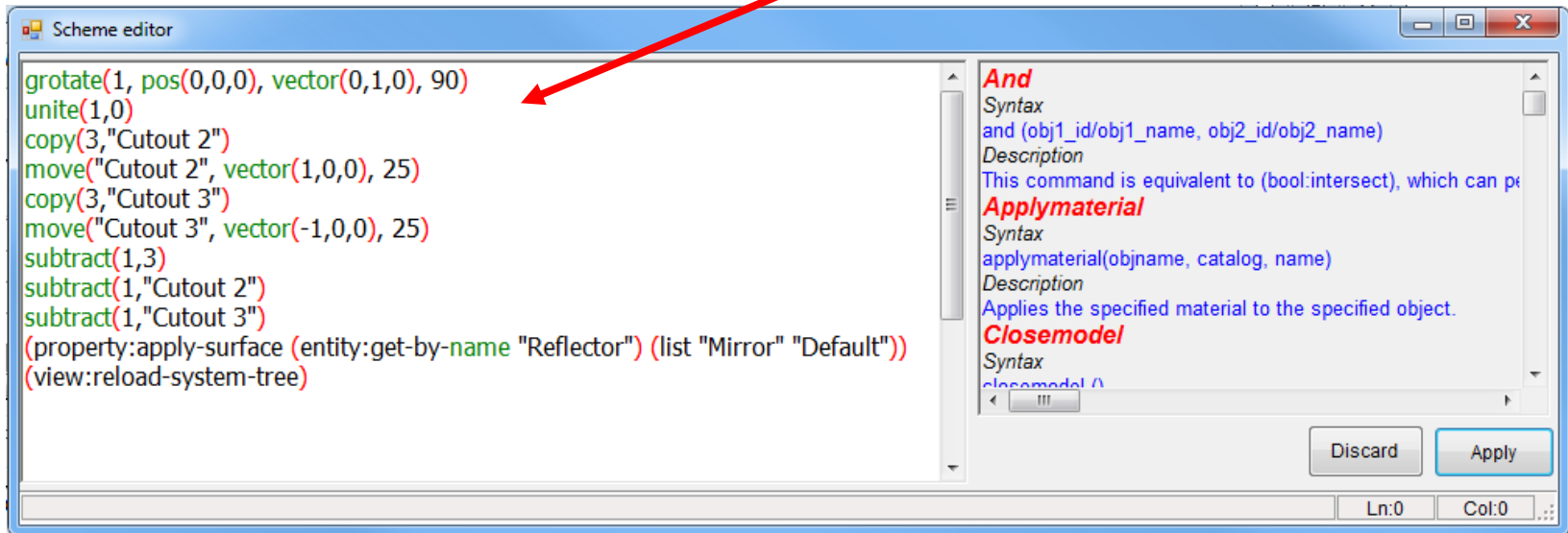
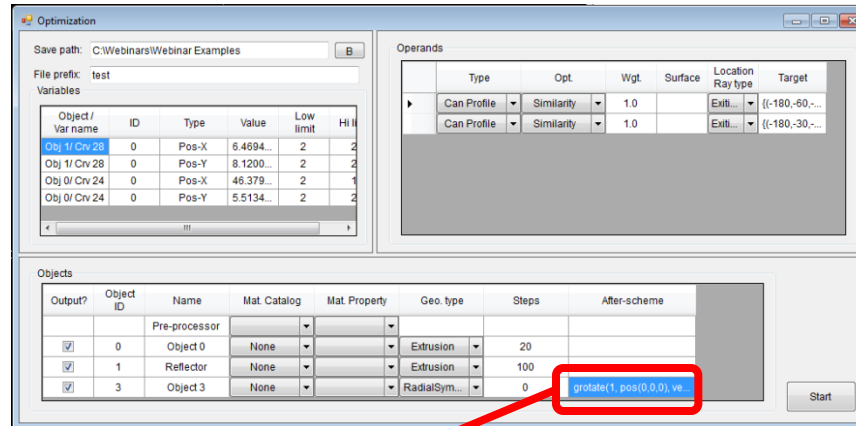
Trough reflector with curved ends and 3 cut-outs for LEDs – TracePro model

Examples



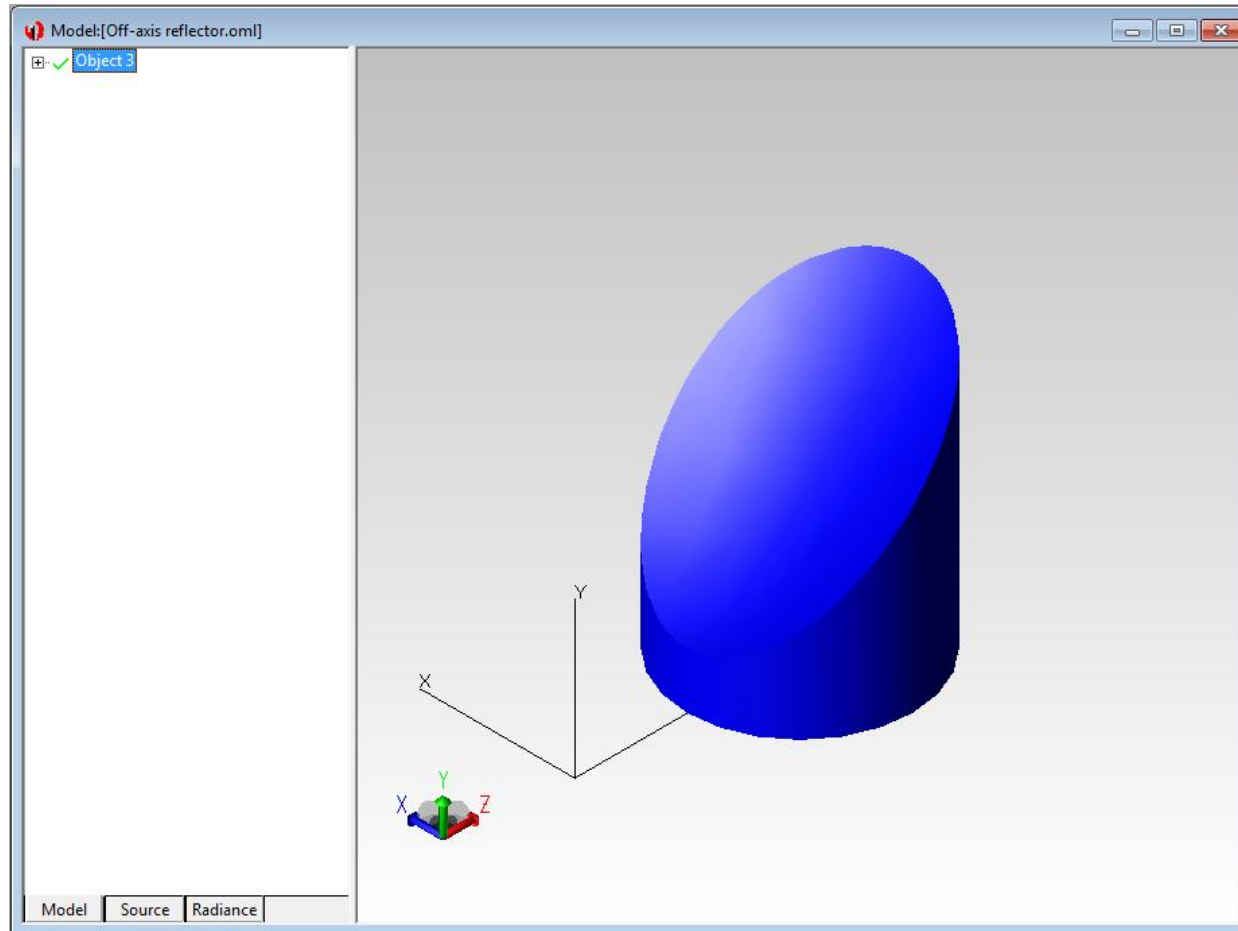
Trough reflector with curved ends and 3 cut-outs for LEDs –
Interactive Optimizer Sketch window

Examples



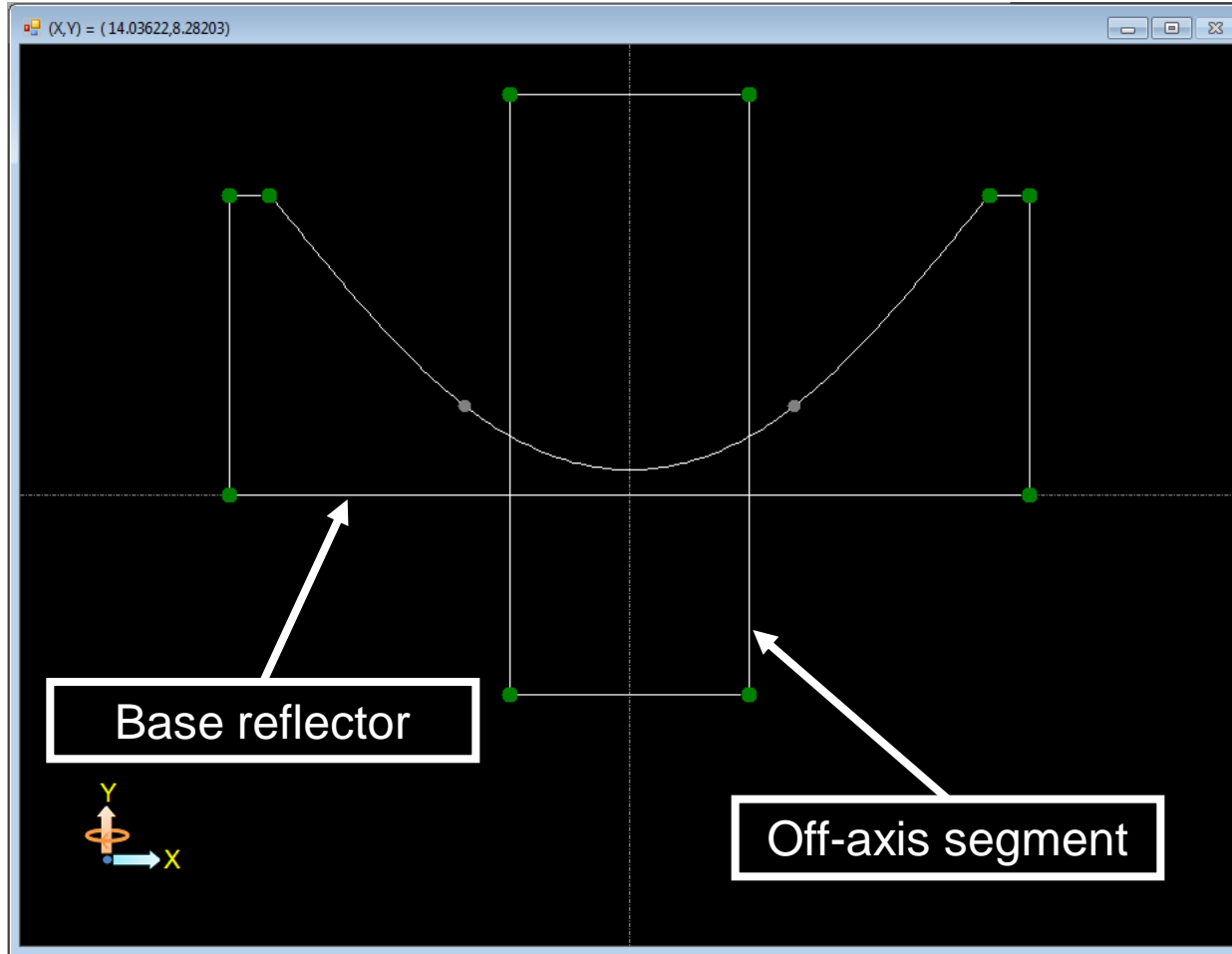
Trough reflector with curved ends and 3 cut-outs for LEDs –
Optimization window and Scheme macro

Examples



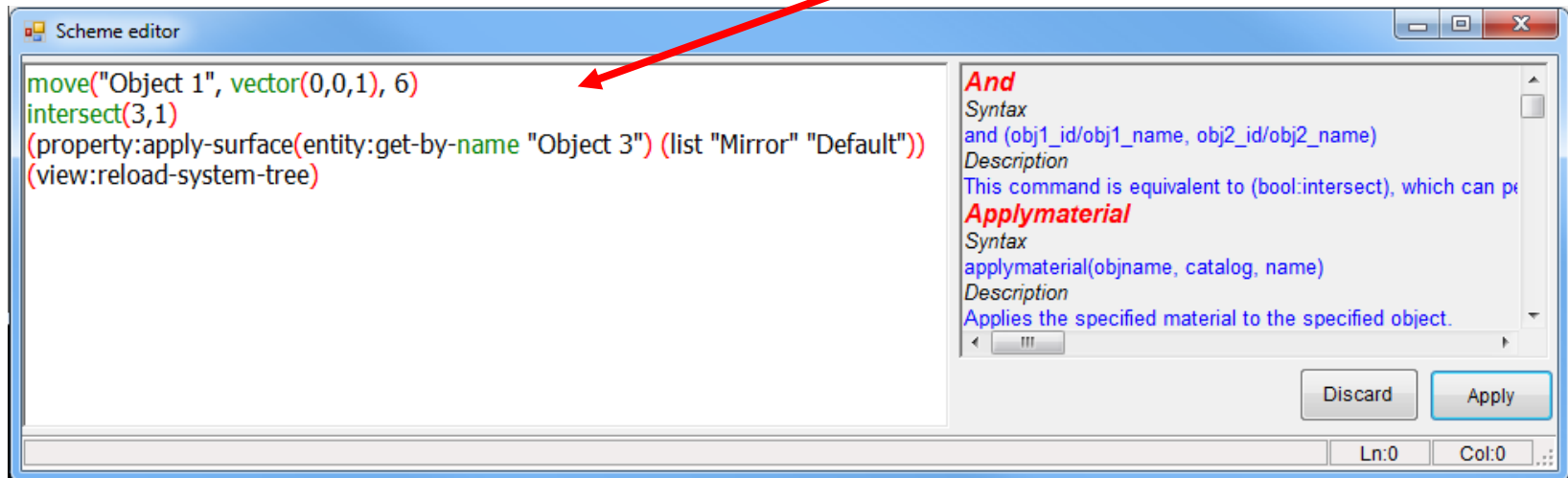
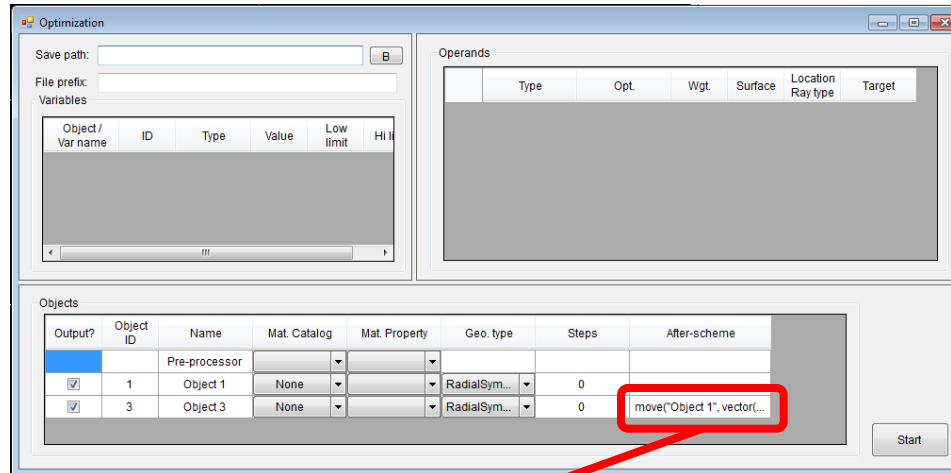
Off-axis reflector – TracePro model

Examples



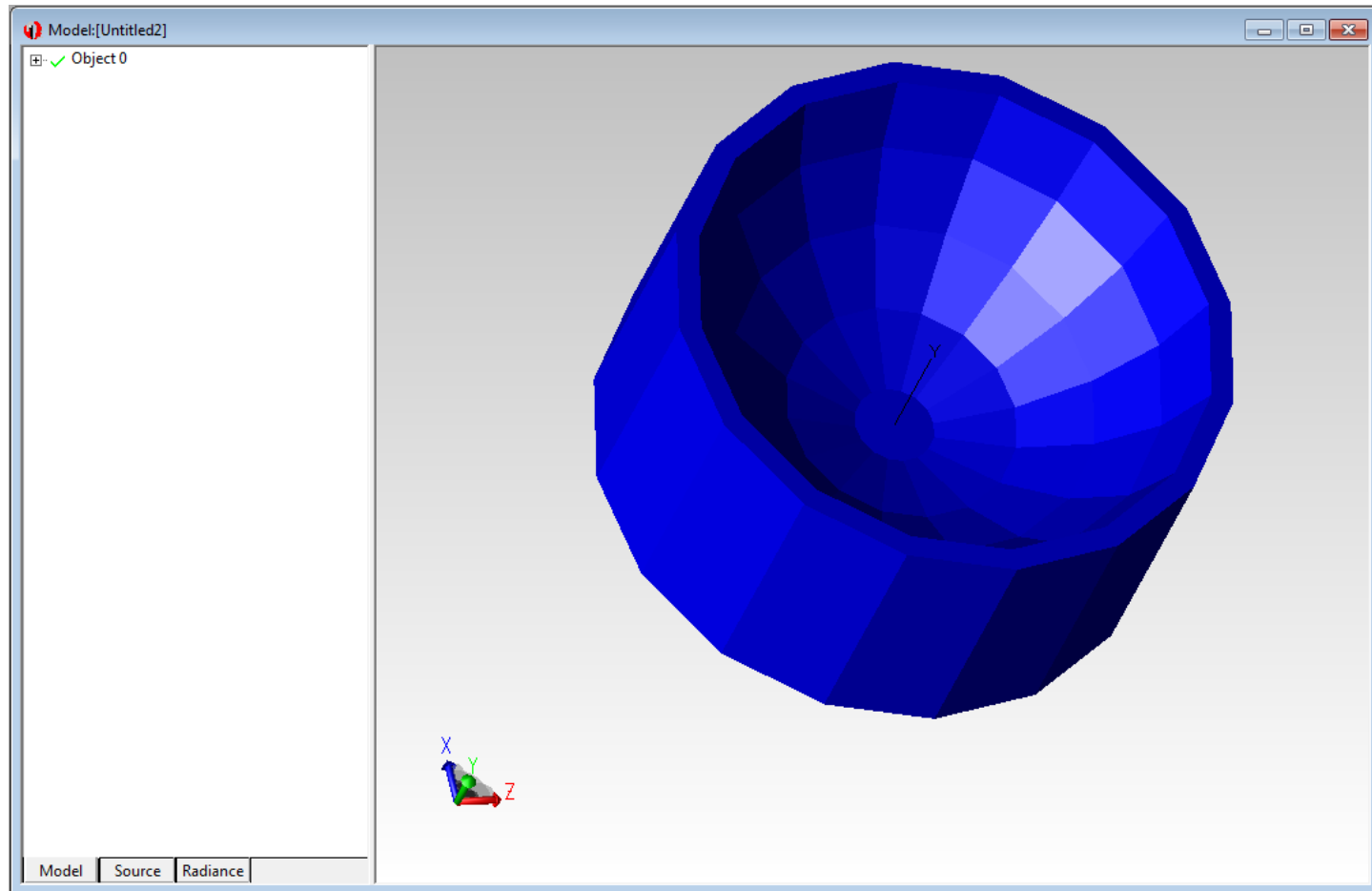
Off-axis reflector – Interactive Optimizer Sketch window

Examples



Off-axis reflector – Optimization window and Scheme macro

Examples



Faceted reflector– TracePro model

Examples

The screenshot displays the Interactive Optimizer Sketch window with a 3D model of a faceted reflector. The reflector is a parabolic shape with a flat base. A white arrow points from a box labeled "Base reflector" to the flat base of the reflector. The Property Editor window is open, showing the following settings:

Description	Value	Variable?	Lower limit	Upper limit
Name				
Curve Type	Sphere			
SurfProp cat...	Default			
Surface Pro...	Mirror			
Reflector?	<input checked="" type="checkbox"/>			
Fresnelized?	<input type="checkbox"/>			
Faceted?	<input checked="" type="checkbox"/>			
Facetizing ...	Equal...			
Facet seg n...	9			
Radius	23.520425	Specif...	0	0

Red arrows point from a red-bordered box containing the text "Select 'Faceted?' and enter the number of Facet segments" to the "Faceted?" checkbox and the "Facet seg n..." field in the Property Editor.

Faceted reflector – Interactive Optimizer Sketch window

Examples

Optimization

Save path: B

File prefix:

Variables

Object / Var name	ID	Type	Value	Low limit	Hi lim
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Operands

Type	Opt.	Wgt.	Surface	Location Ray type	Target
------	------	------	---------	-------------------	--------

Number of Steps for revolving the faceted profile

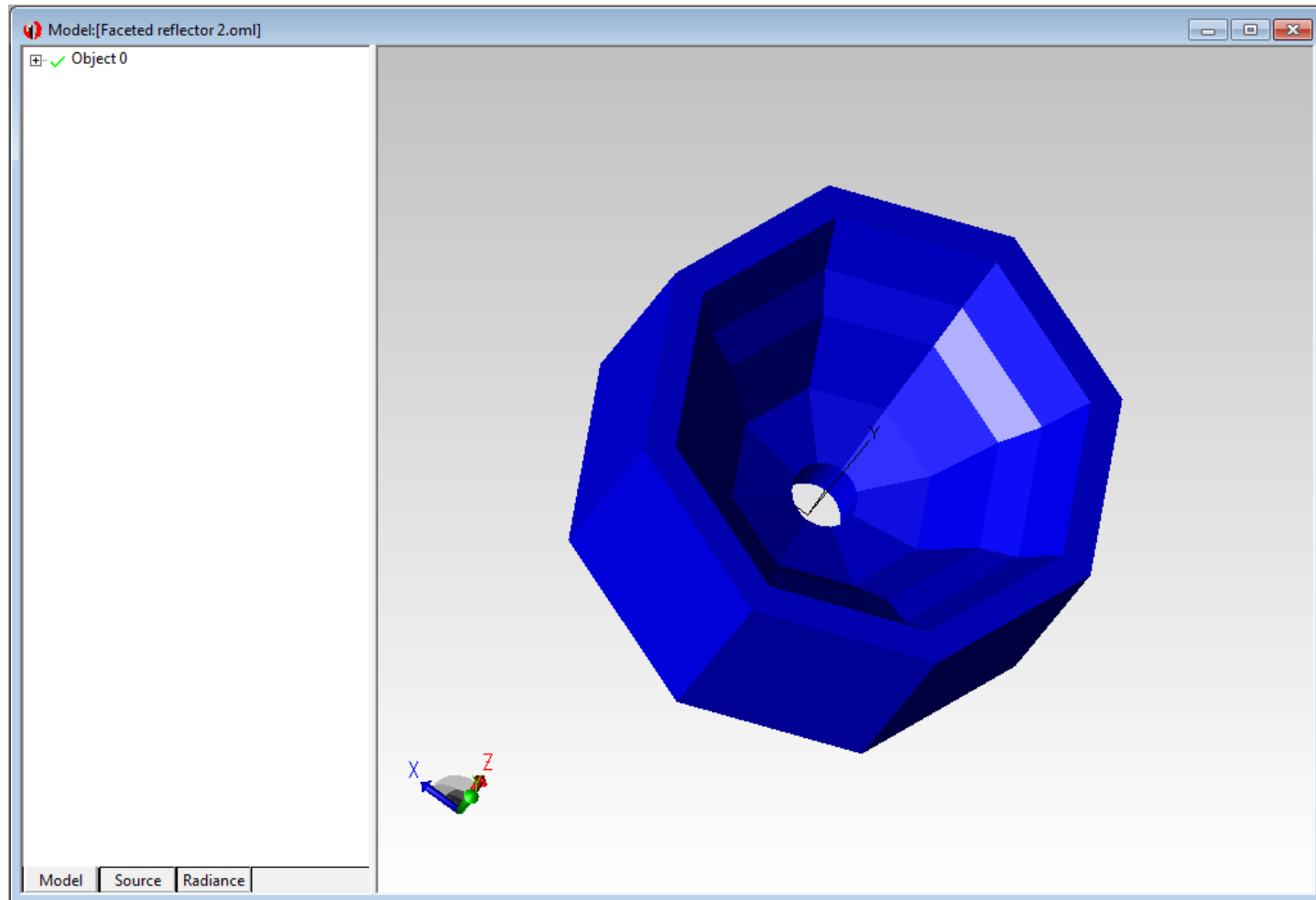
Objects

Output?	Object ID	Name	Mat. Catalog	Mat. Property	Geo. type	Steps	After-scheme
		Pre-processor					
<input checked="" type="checkbox"/>	0	Object 0	None		RadialSym...	16	

Start

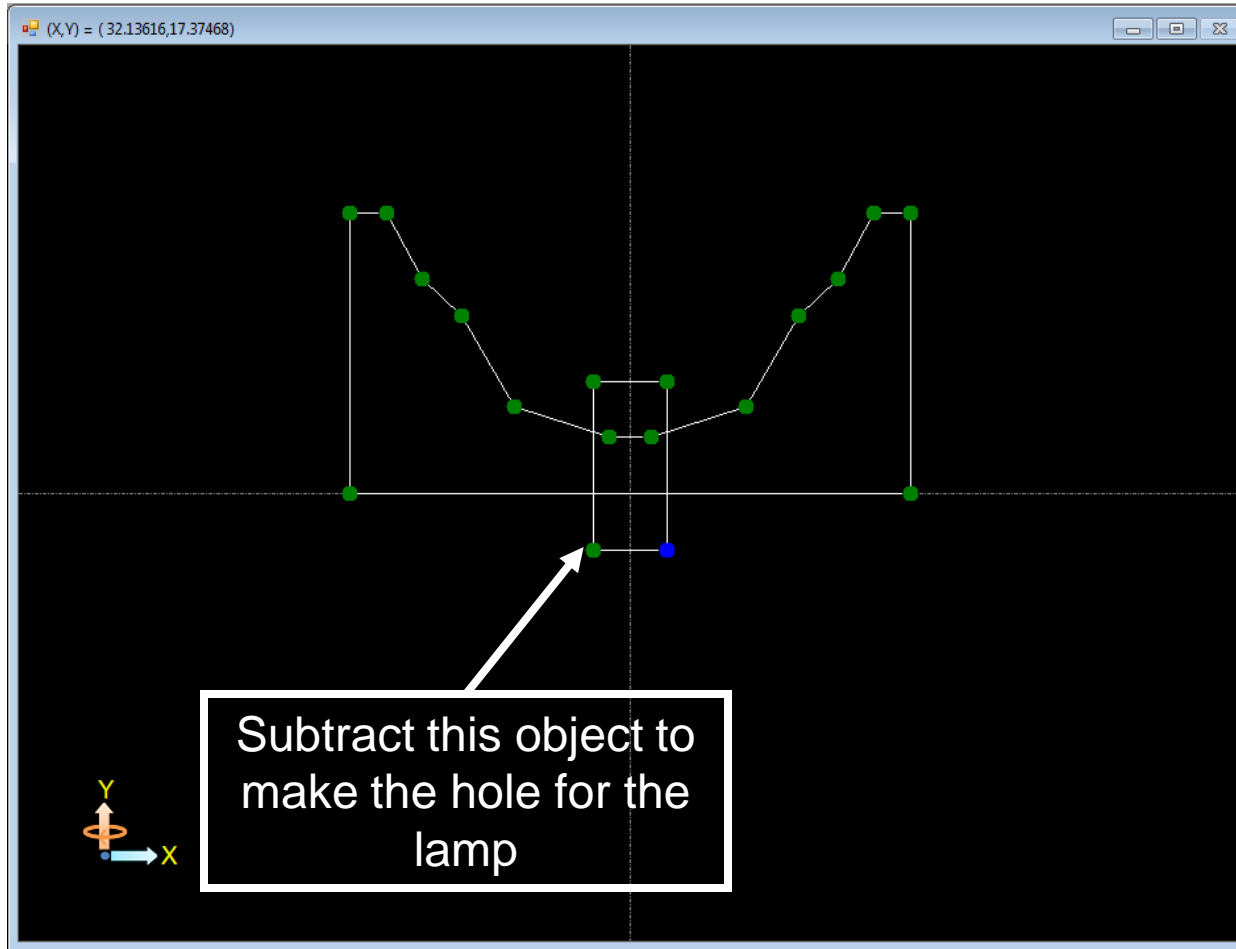
Faceted reflector – Optimization window

Examples



Faceted reflector 2– TracePro model

Examples



Faceted reflector 2 – Interactive Optimizer Sketch window

Examples

Number of Steps for revolving the faceted profile

The Optimization window contains an 'Operands' table and an 'Objects' table. The 'Objects' table is as follows:

Output?	Object ID	Name	Mat. Catalog	Mat. Property	Geo. type	Steps	After-scheme
<input checked="" type="checkbox"/>	0	Object 0	None		RadialSym...	8	
<input checked="" type="checkbox"/>	1	Object 1	None		RadialSym...	0	subtract(0,1)

A red box highlights the 'subtract(0,1)' text in the 'After-scheme' column for Object 1. A red arrow points from the text box above to this cell.

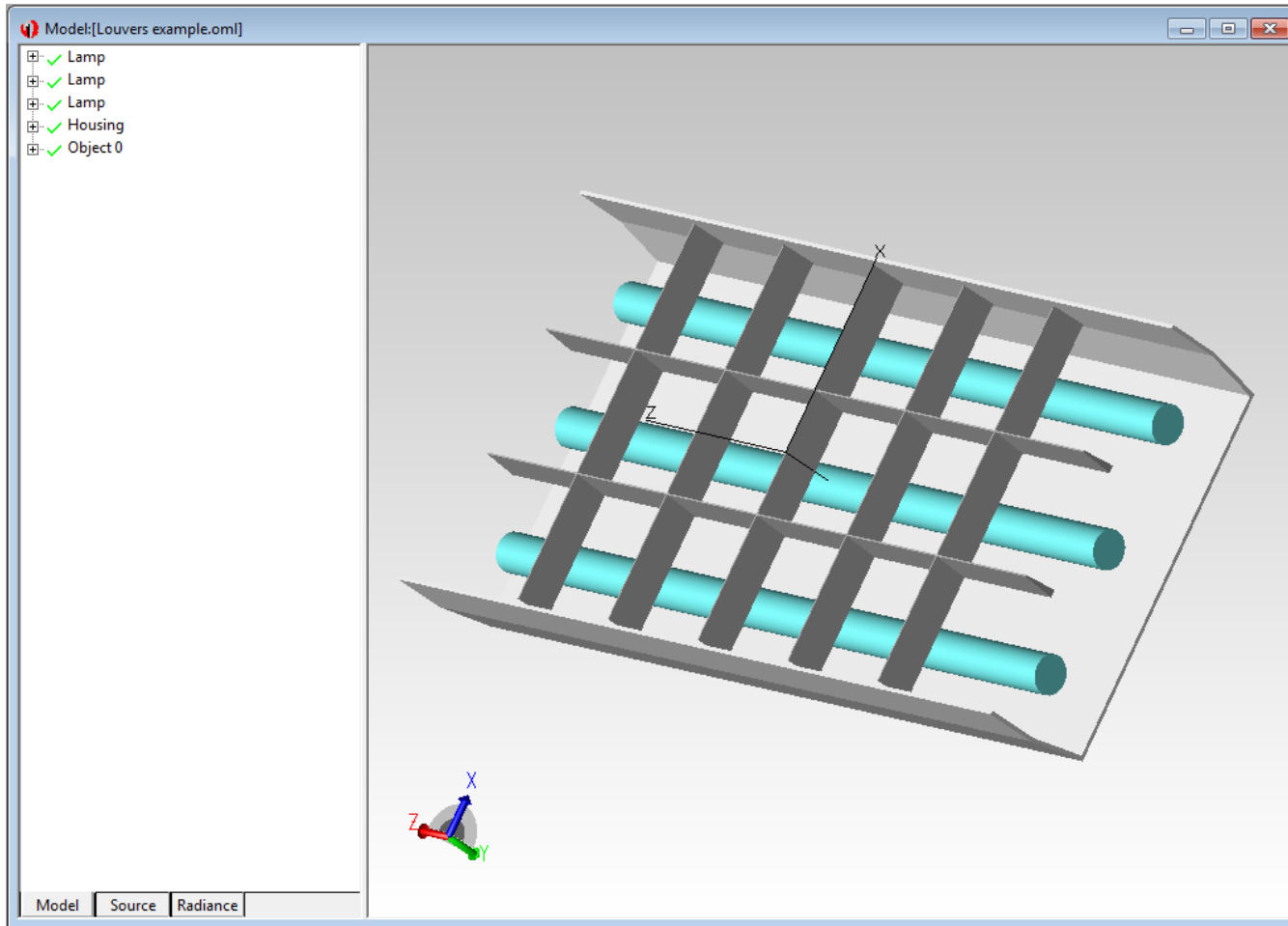
The Scheme editor window shows the macro `subtract(0,1)` in the left pane. The right pane contains the following documentation:

And
Syntax
`and (obj1_id/obj1_name, obj2_id/obj2_name)`
Description
This command is equivalent to (bool:intersect), which can p
Applymaterial

Buttons for 'Discard' and 'Apply' are visible at the bottom right. The status bar shows 'Ln:0 Col:0'.

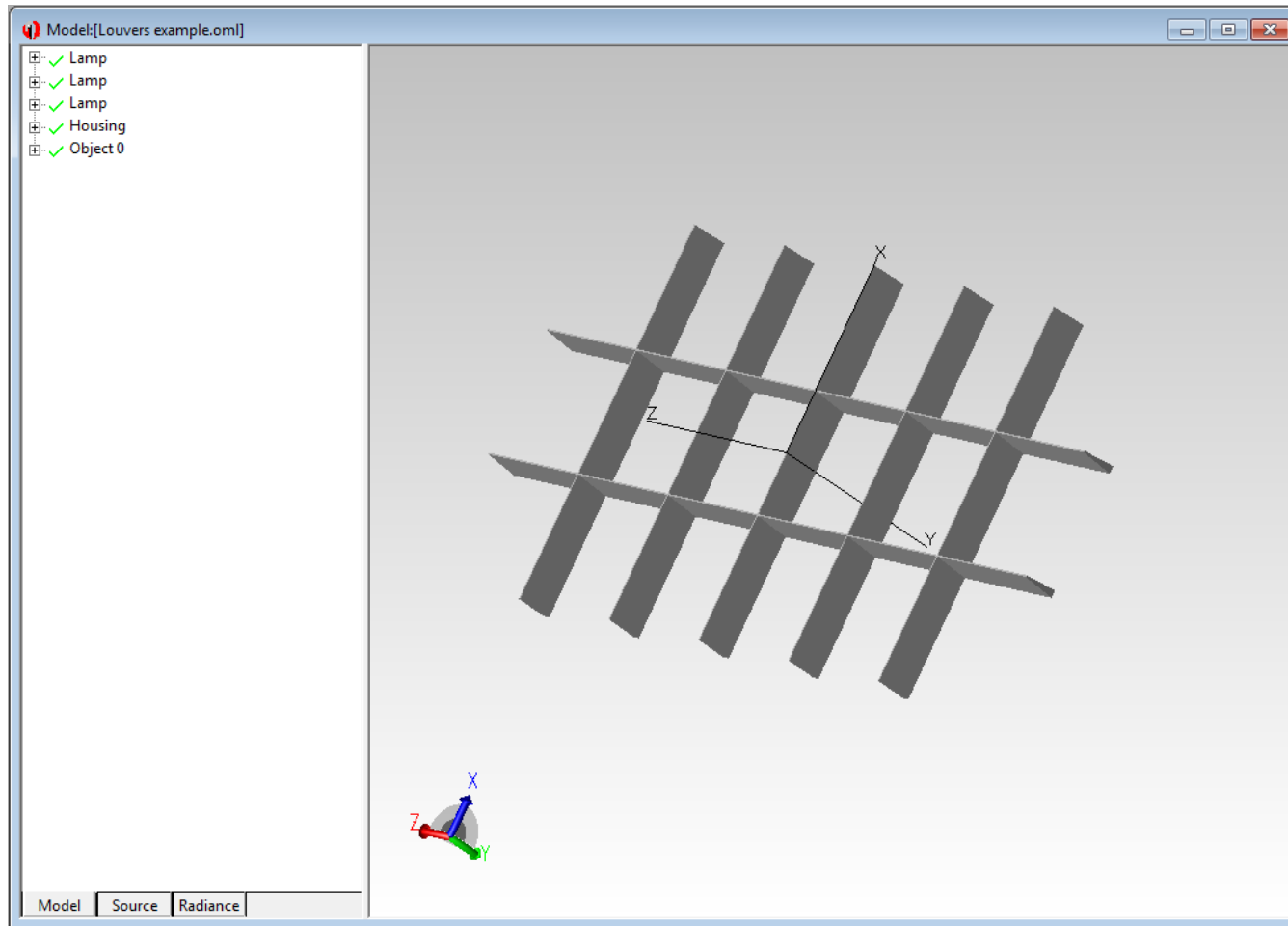
Faceted reflector 2 – Optimization window and Scheme macro

Examples



Fluorescent lamp fixture louvers– TracePro model

Examples



Fluorescent lamp fixture louvers– TracePro model

Examples

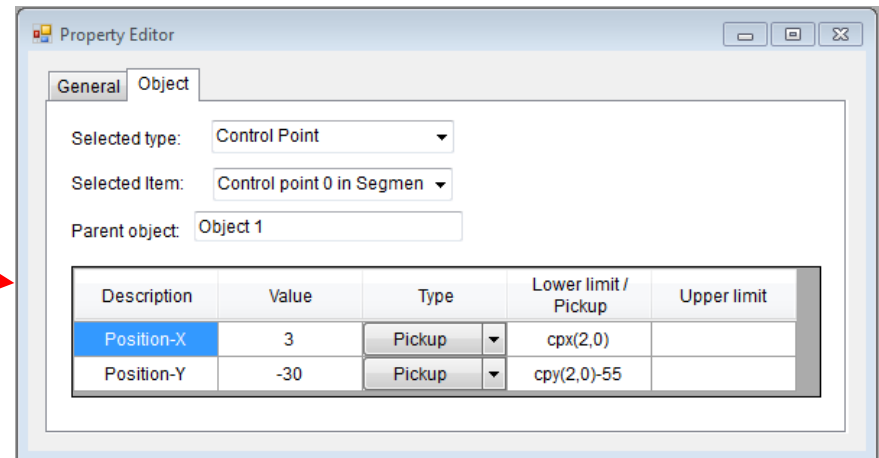
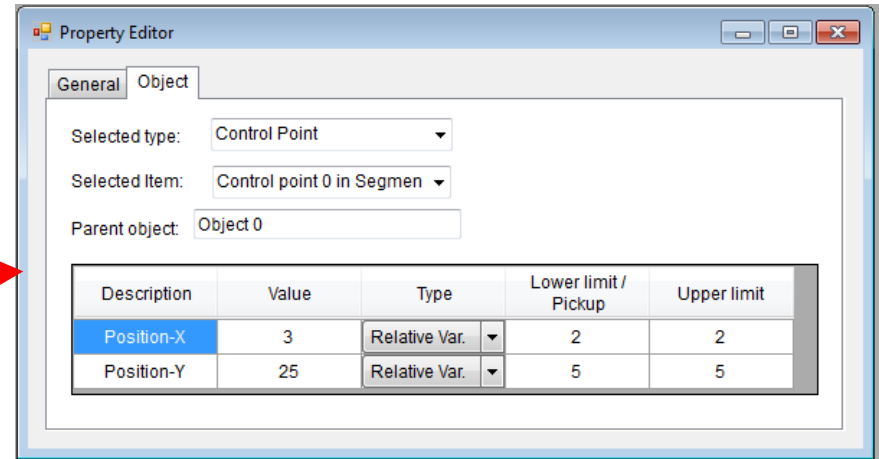
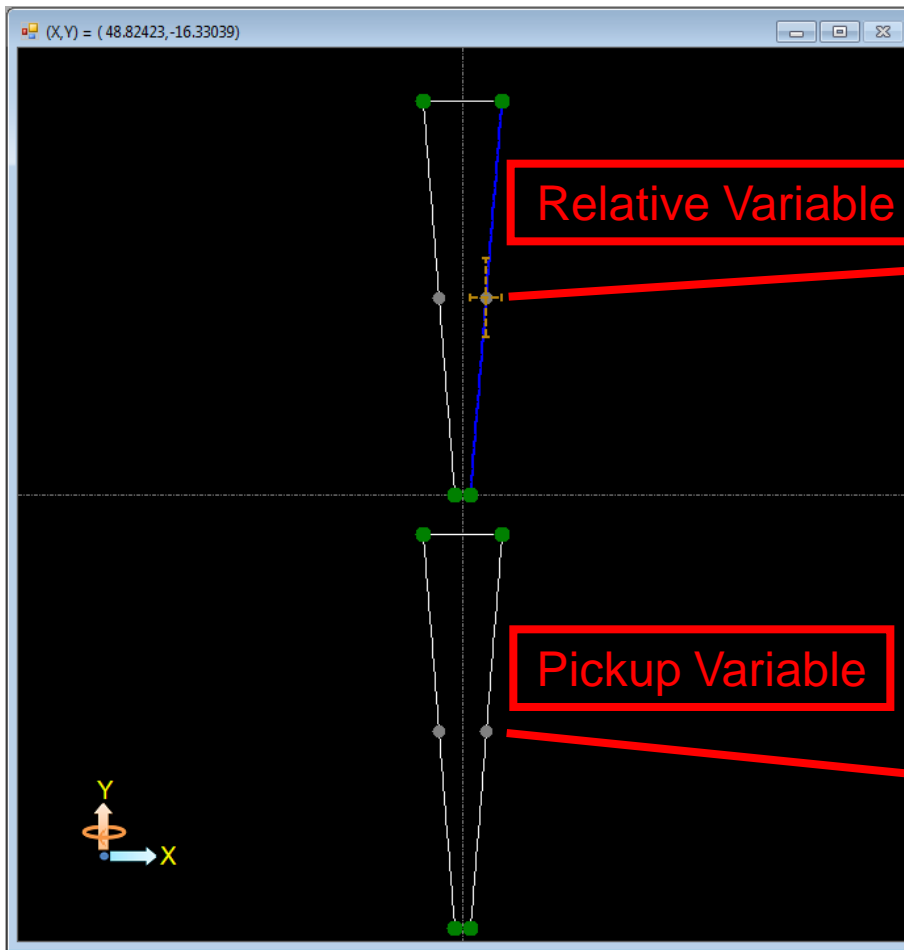
The screenshot displays a software interface with a 2D plot on the left and a Property Editor window on the right. The plot shows a vertical louver mechanism with several control points. A red arrow points from a control point in the plot to the Property Editor. The Property Editor window has a 'General' tab and an 'Object' tab. The 'Selected type' is 'Control Point', the 'Selected Item' is 'Control point 0 in Segmen', and the 'Parent object' is 'Object 1'. Below this is a table with the following data:

Description	Value	Type	Lower limit / Pickup	Upper limit
Position-X	3	Pickup	cpx(2,0)	
Position-Y	-30	Pickup	cpy(2,0)-55	

A red callout box with a red border contains the text: "Use the Pickup option so that these 2 points always move together". Red arrows point from this box to the 'Pickup' dropdowns in the table and to the corresponding control points in the plot.

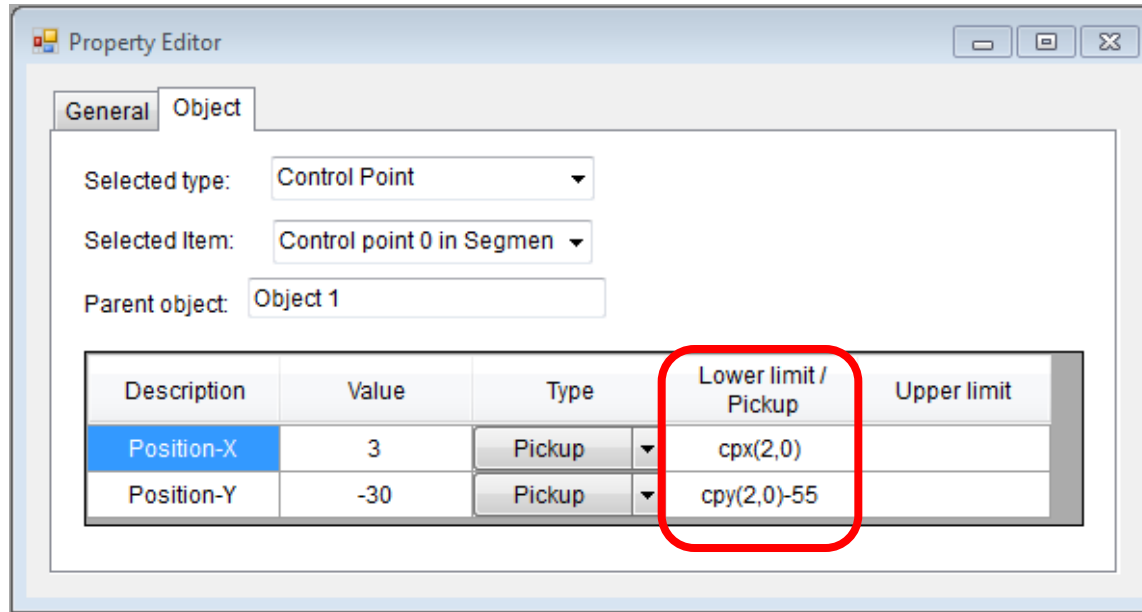
Louvers– Relative and Pickup variables

Examples



Louvers– Relative and Pickup variables

Examples



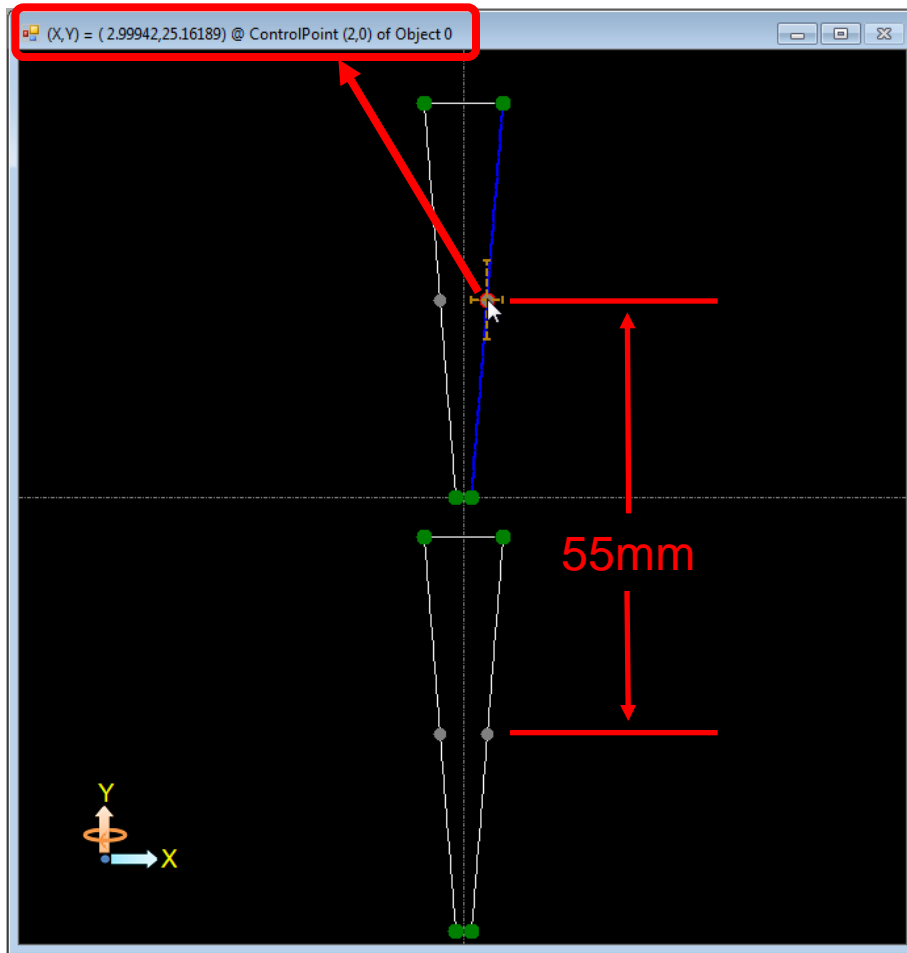
$cpx(2,0)$ = This control point will always have the same X value as Control Point (2,0)

$cpy(2,0)-55$ = This control point will always have a Y value 55mm below Control Point (2,0)

For Segment Points, change **cpx** and **cpy** to **spx** and **spy**

Louvers– Pickup variable

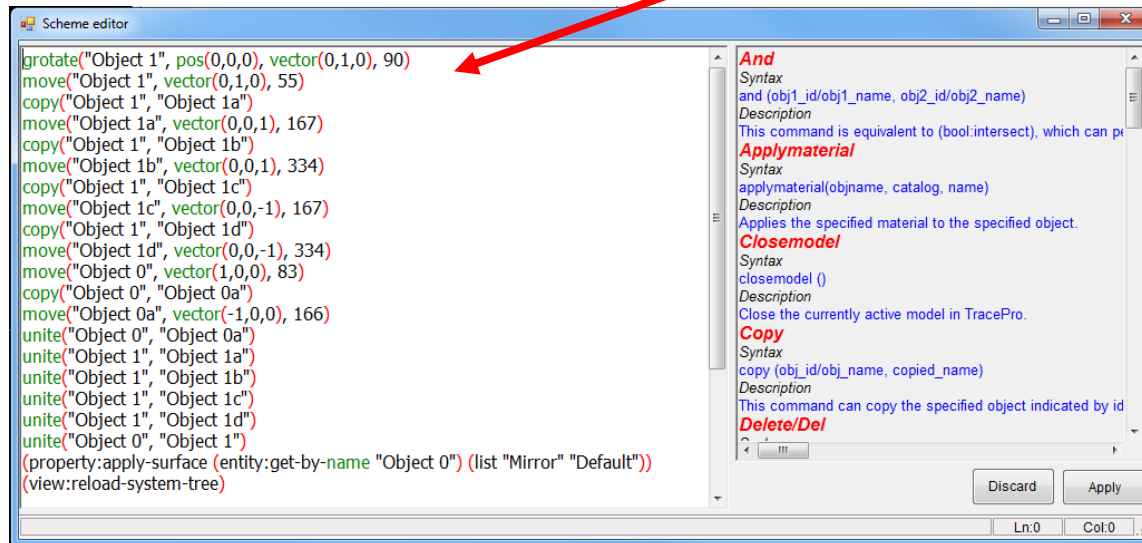
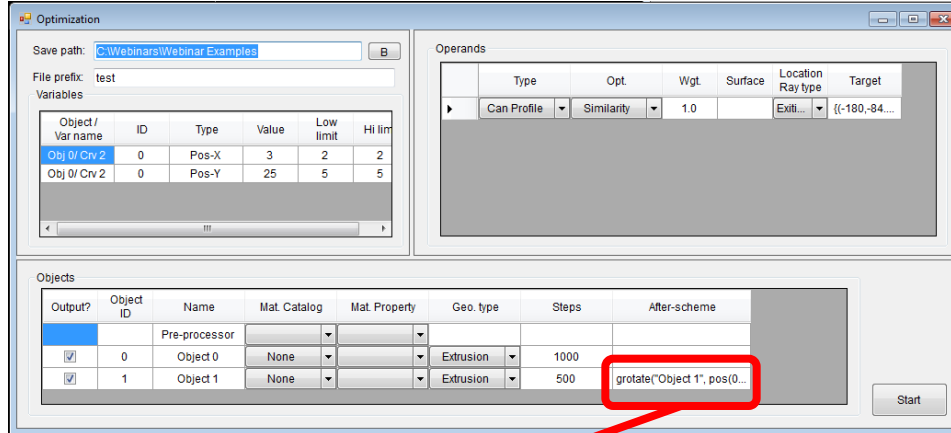
Examples



- To find the Segment number and Control Point number for a Control Point, click on the Control Point in the sketch window and read the values at the top of the sketch window
- Format is (segment #, control point #)

Louvers– Control Point number

Examples



Louvers– Optimization window and Scheme macro

Thank You

Questions and Answers

**For Additional Information
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