



Operating Instructions Converter 801

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1 Introduction

By means of the goniometer type Rigo801, it is possible to generate ray files of measuring objects in the TechnoTeam-specific ray data format (file ending *.ttr). Afterwards, these files can be converted into other data formats using the Converter801 program. Here, the following formats are possible:

- TechnoTeam-luminous intensity distribution (file ending *.ttl)
- Ray files for ASAP (Breault Research Organisation company, file ending *.dis)
- Ray files for LucidShape (Brandenburg GmbH company, file ending *.ray)
- Ray files for LightTools (lighttools company, file ending *.txt)
- Ray files for Zemax (ZEMAX Development Corporation, file ending *.dat)
- Ray files in the ASCII-format (for test and comparison purposes, file ending *.txt)
- Ray files for TracePro (Lambda Research Corporation, USA, file ending *.src)
- Ray files for Speos (Optis company, France, file ending *.ray)
- Ray files for SimuLux (infotec soft- u. hardware GmbH company, file ending *.ray)

In addition, the generated TechnoTeam-luminous intensity distributions (*.ttl) can be exported into the following formats:

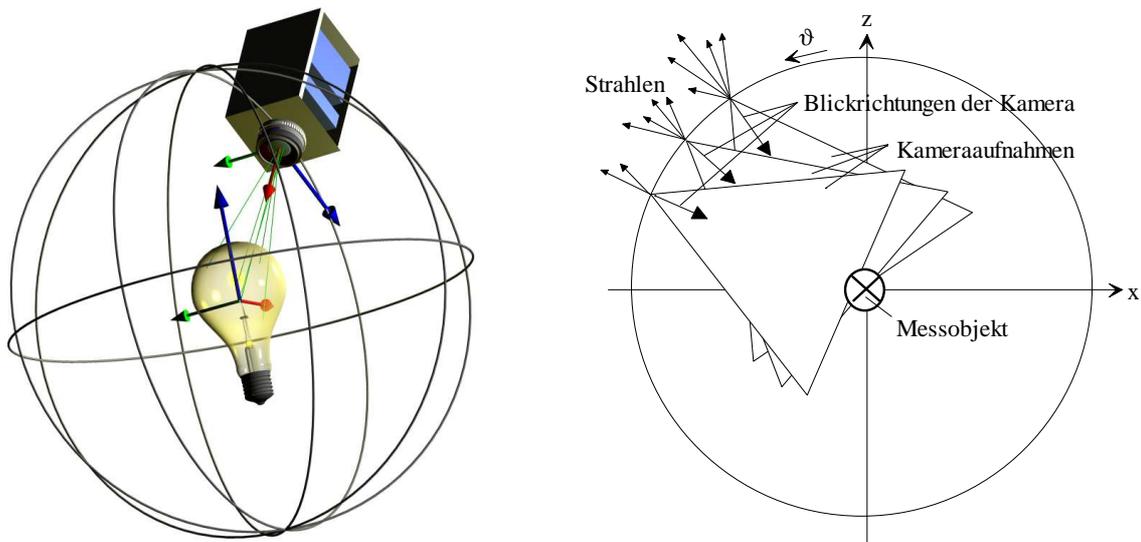
- ASCII-files (universal text-readable format, file ending *.txt)
- IES-files (IES LM-63-02, Illuminating Engineering Society, file ending *.ies)
- Eulumdat-format (originally Light Consult Inc., file ending *.ldt)
- Luminous intensity of projection image (TechnoTeam company for LMK Labsoft, file ending *.pf)

The program **Converter801** can be installed on any computer as no access to the goniometer's hardware is necessary. The requirements placed on the hardware of the converting computer are considerably lower than those placed on the goniometer computer. Only the converting time depends on the quality of the computer.

At first, the documentation contains two general chapters. Chapter 2, „Basic principles of ray conversion“, describes in a general way the measuring principle applied for ray data acquisition whereas in Chapter 3, „General program features“, the handling of the converting program as well as those program features which are valid for all conversion formats are explained. In Chapters 4 „Generating luminous intensity distributions“ and 5 „Generating ray files“, the export into the formats supported is described.

2 Basic principles of ray conversion

During measurement, the camera was moved on a spherical surface around the measuring object by rotating the two goniometer axes φ and ϑ , thus allowing luminance images of the measuring object to be made in very many different positions. From each luminance image, a ray bundle is calculated in the coordinate system of the measuring object by using the geometry and the position of the camera. The ray bundles are saved sequentially in a special format in a TechnoTeam-ray file. To each ray the information concerning the initial point, the direction and the amplitude of the ray is assigned.



The structure of the ray files generated (file ending *.trr) results from the algorithm by means of which images have been captured and processed during measurement:

- The coordinate system in which the rays are saved is a Cartesian coordinate system where the directions of the single axes X, Y and Z result from the angular definitions for φ and ϑ of the goniometer.
- The starting point of a ray was calculated from the position (φ , ϑ , radius of the camera sphere) of the camera at the moment of the image capture.
- The direction of the ray results from the viewing direction of the camera at the moment of the image capture and also from the viewing direction of the image point with regard to the optical axis of the camera.
- The luminous flux portion of a ray is calculated from several factors such as the number of rays in an image, the total luminous flux of the current image as well as the size of the spherical segment which corresponds with the current camera capture. The region of the spherical segment is calculated from the angular distances of the current capture position to the four directly adjacent capture positions.

For the conversion into other formats, the following aspects must be taken into consideration:

- The position of the target coordinate system may be coupled to the measuring object and its useful position. Thus, it might be necessary to change the position of the coordinate

system in which the coordinates and the directions of the rays are given out towards the coordinate system of the measuring object.

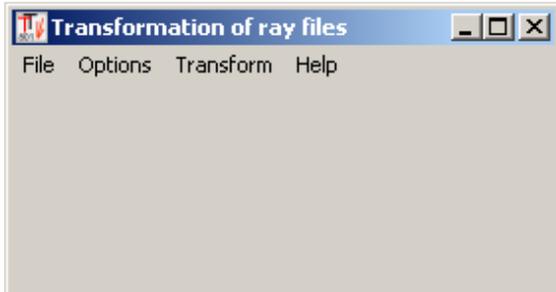
- In order to be able to use the ray data of the measuring object, it is often useful to lay the starting points of the rays on a body surface which is smaller than that of the spherical surface of the camera positions. For this purpose, raytracing up to the intersection point of the rays on the given body (light exit surface, target geometry) is necessary.
- The number of rays in the target file to be generated differs from that in the source file. In general, the desired number of rays is smaller than the one which is available.
- The amplitudes of the rays must be converted. In the source files, amplitudes of different sizes are employed; some target file formats require the output of unit rays.

The position of the target coordinate system and also the position of the starting points of the rays constitute global parameters of ray data conversion. These settings are described in Chapter **3.3** „Common options for conversion“.

3 General program features

3.1 Start of program

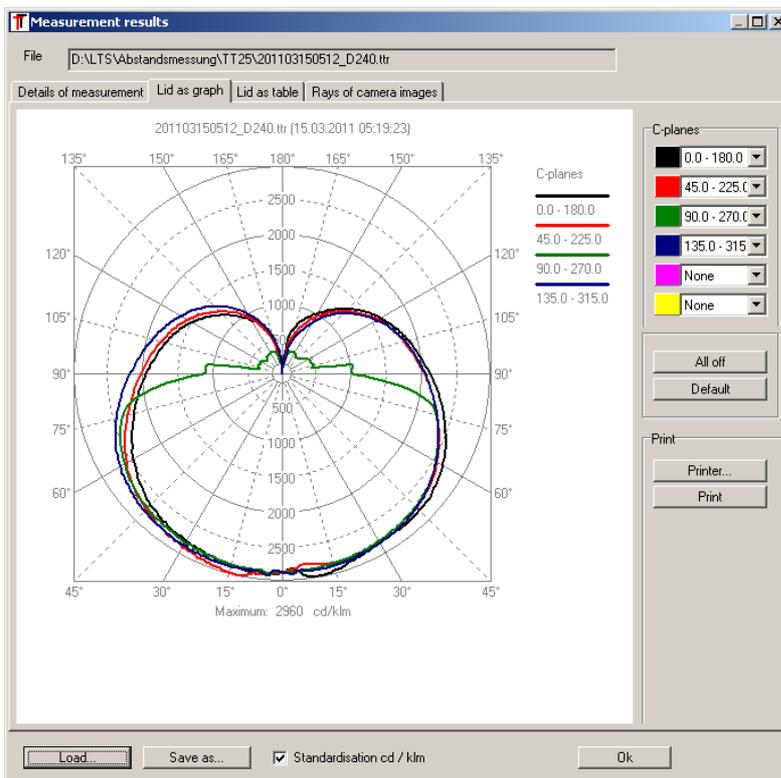
The program can be started via the Windows start menu (e.g. Start → Program → TechnoTeam → Converter801). Alternatively, icons with the corresponding links can be installed on the desktop and used for starting the program by a double click.



- In the pop-up menu „FILE“ a ray file can be loaded for conversion via the menu entry „FILE | OPEN...“.
- In the pop-up menu „OPTIONS“ settings can be made which are independent of the respective output format.
- In the pop-up menu „TRANSFORM“ the desired target format can be chosen and conversion can be effected.

3.2 Loading of a TechnoTeam-ray file (*.ttr)

Using the menu item „FILE | OPEN...“ the dialog „Measurement results“ is opened. By pressing the „Load...“ button in this dialog, an Open File dialog is shown where an available TTR file can be selected and loaded.



After loading, the measuring data recorded by the Rigo801 program, just as the measuring parameters and any information entered by the user before measurement are available on the tab windows „Details of measurement“, „Lid as graph“, „Lid as table“ and „Rays of camera images“. The documentation of the Rigo801 program contains a description of the contents of

the single tab windows from the dialog „MEASUREMENT RESULTS“. This dialog has already been presented here in connection with the execution of a measurement. After loading the desired ray file, the dialog can be closed using the „OK“ button. Now, the ray file is available as source file for all subsequent conversions.

Using the dialog, it is also possible to read again and edit TechnoTeam-luminous intensity distribution files (.ttl). As no ray files can be generated from these files, the menu items for converting in the pop-up menu „CONVERT“ remain locked after loading a TTL-file.*

3.3 Common options for conversion

3.3.1 Conversion of the coordinate system

Goniometer coordinate system

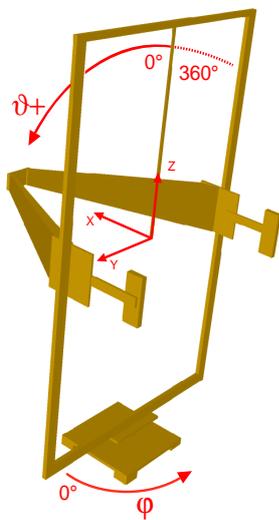
During measurement, the ray data are filed in a coordinate system in which the position of the axes X, Y, Z orient itself towards the axes of rotation φ and ϑ of the goniometer. The two axes of rotation are not commutative to each other. In any case, it holds: The φ -axis changes the position of the ϑ -axis of the goniometer.

Due to the movement of the two axes, a spherical coordinate system is fixed in which the following relations between the single quantities are valid:

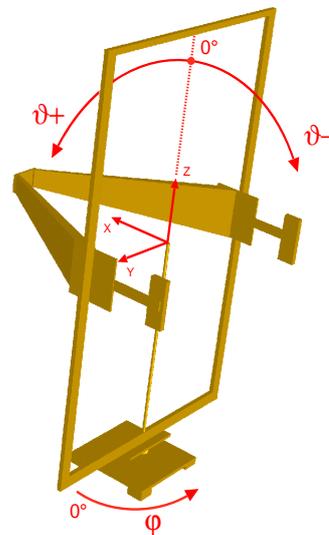
$$x = r \sin \vartheta \cos \varphi$$

$$y = r \sin \vartheta \sin \varphi$$

$$z = r \cos \vartheta$$



Lamp suspension at the top



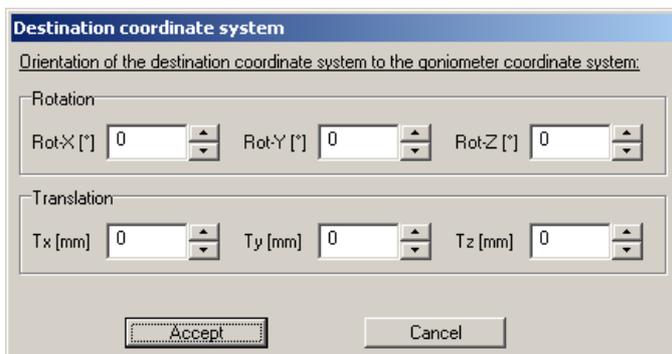
Lamp suspension at the bottom

The above figures show the position of the camera in this coordinate system just as the various ϑ -domains as a function of the configuration of the lamp suspension.

- For $\vartheta=0^\circ$ the camera is at the top, for $\vartheta=180^\circ$ it is at the bottom.
- In the goniometer position ($\varphi=0^\circ$, $\vartheta=90^\circ$) the camera is on the positive side of the x-axis (as shown).
- In the goniometer position ($\varphi=90^\circ$, $\vartheta=90^\circ$) the camera is on the positive side of the y-axis.
- If the lamp suspension is fixed at the top, then ϑ is defined in the range from 0° to 360° .
If the lamp suspension is fixed at the bottom, then ϑ is defined in the range from -180° to 180° .

Coordinate conversion

The orientation of the coordinate system of the rays or also of the luminous intensity distribution is often linked with the object of measurement and its normal position. This means that the raw data available in the goniometer coordinate system must be transferred to the coordinate system of the object of measurement. The necessary coordinate conversion can be effected in the program via the menu item „OPTIONS | TRANSFORMATION COORDINATE SYSTEM ...“. When selecting this menu item, the following dialog is opened:

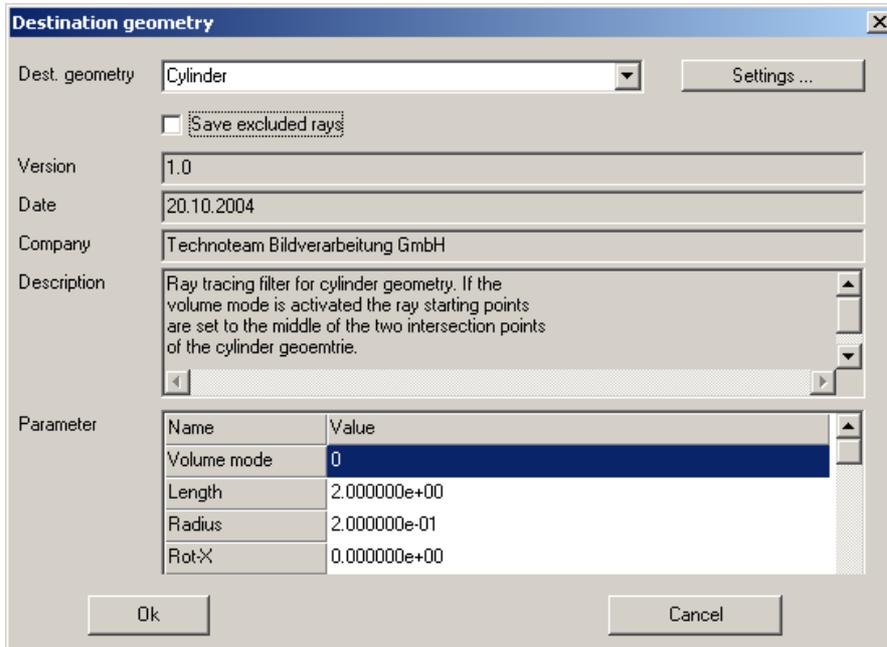


The parameters set of the coordinate conversion indicate the position of the target coordinate system towards the goniometer coordinate system. First, rotation takes place, then the translation of the coordinate system. The settings are made by pressing the „Accept“-button. If the dialog is called again (also after restarting the program), the settings made last are displayed as default settings.

3.3.2 Starting points of the rays

As already mentioned in Chapter 2, „Basic principles of ray conversion“, the starting points of the rays are found on the sphere where the camera is positioned during measurement. However, in order to be able to use the ray data of the object of measurement, it is often useful to lay the starting points of the rays on a body surface which is smaller than the surface of the camera sphere. For this purpose, it is necessary to effect raytracing up to the piercing point with a given body.

The calculation of the points of intersection with a target geometry is carried out via an open API – interface (documentation available upon request) by means of DLL libraries. The target geometry is selected using the menu item „OPTIONS | TARGET GEOMETRY ...“.



The dialog „Target geometry“ offers a selection list of the raytracing libraries included, and contains the current parameters for the target geometry chosen. By pressing the button „Settings ...“, the parameters for the respective geometries can be fixed. In the box „Save excluded rays“ the user may determine whether rays which do not intersect the target geometry shall be saved in a separate file.

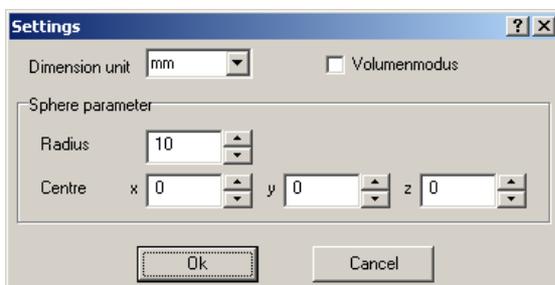
Please note: The data refer to the goniometer coordinate system, i.e., they are valid before the rotation of the ray directions or also ray loci into the result coordinate system.

Presently, the following geometries are available for raytracing:

Camera sphere

As mentioned earlier, this setting is a default setting. All rays start from the respective camera positions and spread out away from the centre of the camera sphere.

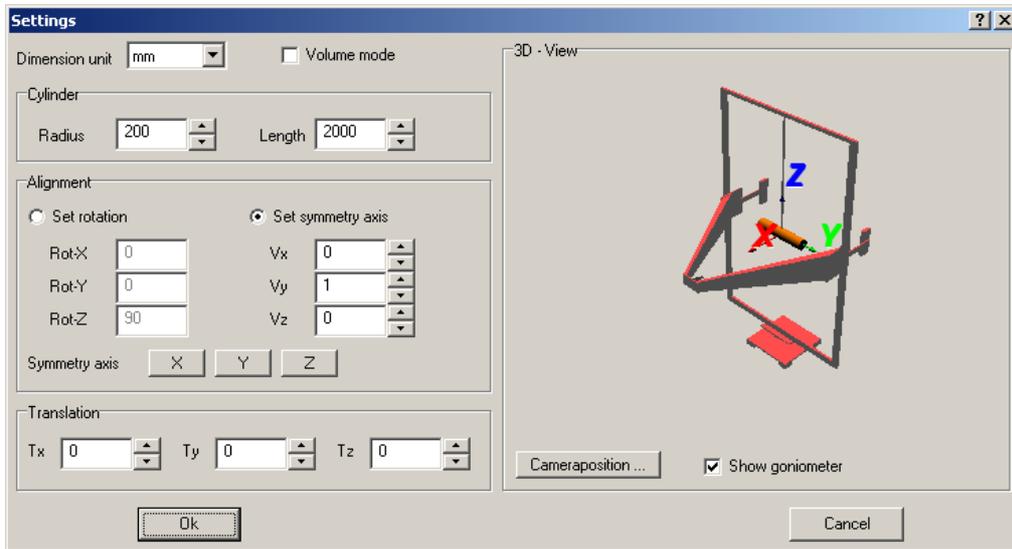
Sphere



Using this dialog (dialog section „SPHERE PARAMETER“) the position and the radius of a sphere can be fixed. The unit of measurement for the indications of size and orientation of the following dialog sections can be modified via the combined box „Dimension unit“. If the selection box „VOLUME MODE“ is activated, then the starting points of those rays which

intersect the raytracing body do not lie on the body surface any more. Instead, they are calculated as mean value of the two intersection points, i.e., they lie within the volume.

Cylinder

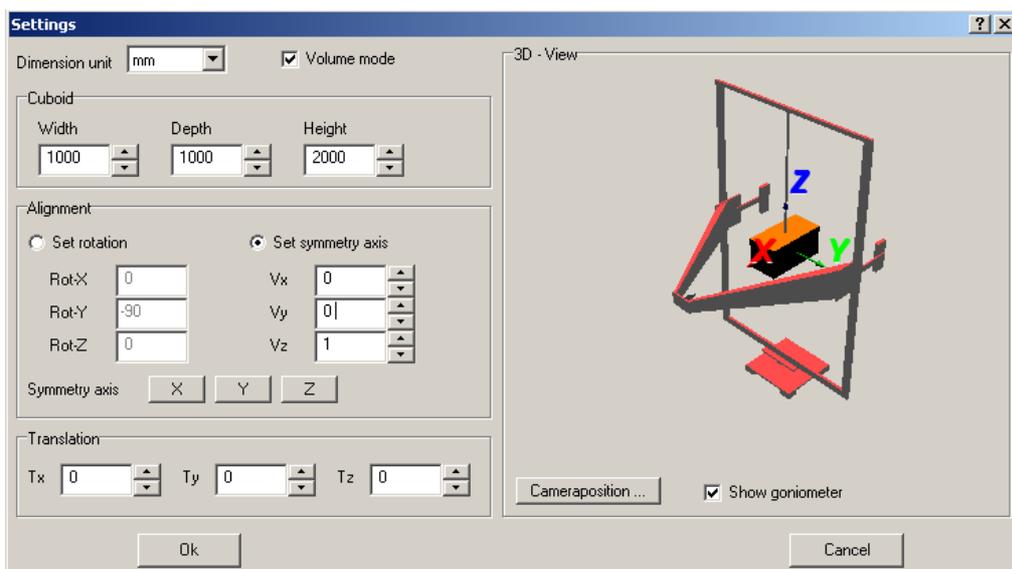


Using this dialog, the position, the radius and the length of a cylinder can be fixed. For the orientation of the cylinder, the modes „SET ROTATION“ and „SET SYMMETRY AXIS“ are available. As for the rotation, note that the cylinder axis is rotated from the X-axis in the order X, Y, Z. After the rotation of the cylinder axis, the translation is effected by the given parameters „Tx“, „Ty“ and „Tz“.

The dialog section „3D – VIEW“ shows the resulting position of the cylinder in the goniometer coordinate system. This view can be modified both by means of the mouse (left-hand and right-hand mouse button) and via the button „CAMERA POSITION ...“.

The dialog elements „DIMENSION UNIT“ and „VOLUME MODE“ have already been explained for the target geometry „Sphere“.

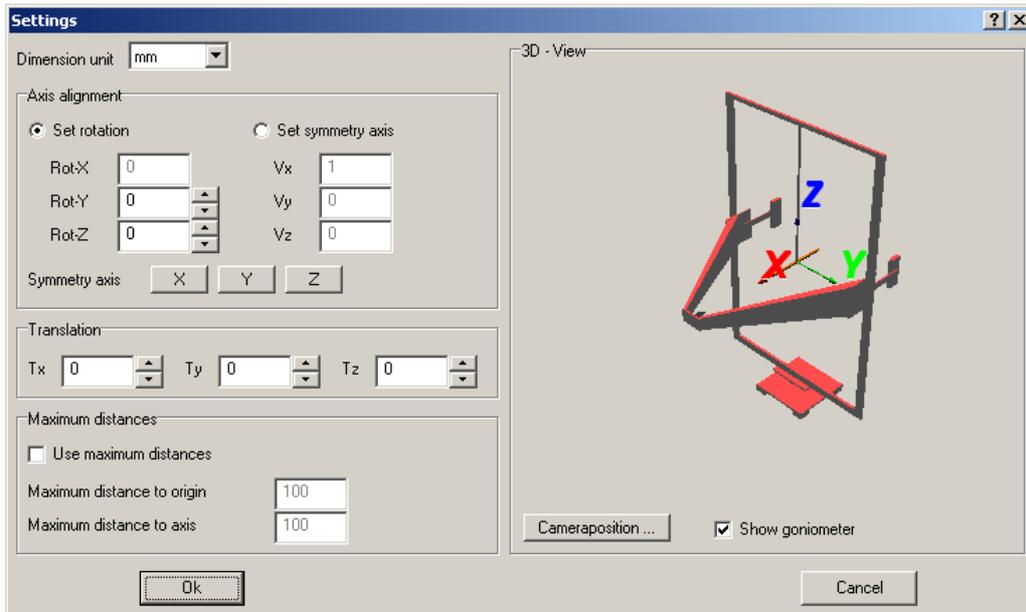
Cuboid



Using this dialog, the position and the side lengths of a cuboid can be fixed. „WIDTH“ is the side length in the direction of Y, „DEPTH“ is the length in the direction of X, and „HEIGHT“ is the length in the direction of Z.

The explanations concerning the dialog elements „DIMENSION UNIT“ and „VOLUME MODE“ are given under the target geometry „Sphere“, the elements „ALIGNMENT“, „TRANSLATION“ and „3D-VIEW“ under the target geometry „Cylinder“.

Minimum distance between axes



Using this dialog, the position of a virtual axis in the measurement space can be fixed.

In the dialog section „MAXIMUM DISTANCE“, the rays can be selected. If the selection box „Use MAXIMUM DISTANCES“ is activated, the input box „MAXIMUM DISTANCE TO ORIGIN“ displays an upper threshold value for the smallest distance of each ray to the coordinate origin, whereas the input box „MAXIMUM DISTANCE TO AXIS“ displays an upper threshold for the smallest distance of each ray to the virtual axis.

The dialog element „DIMENSION UNIT“ has already been explained for the target geometry „Sphere“, and the elements „AXIS ALIGNMENT“, „TRANSLATION“ and „3D-VIEW“ for the target geometry „Cylinder“.

3.4 Batch processing

The batch processing feature allows a number of conversion orders to be collected, parameterized, saved and finally processed. This makes parameterization before each single conversion superfluous. Any saved batch processing files can be modified or used several times.

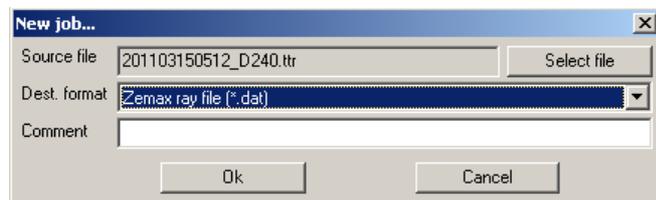
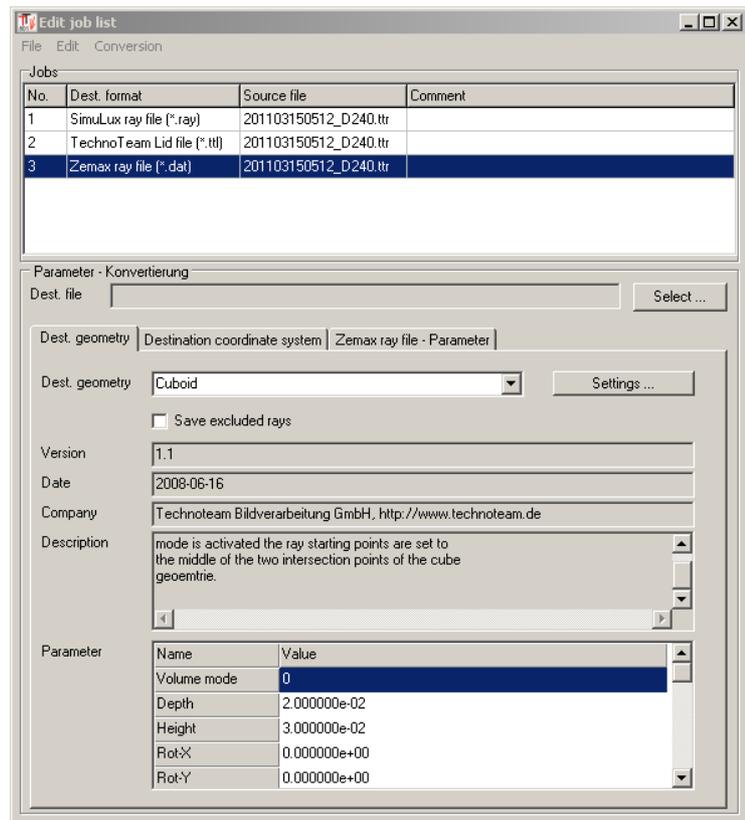
3.4.1 Editing jobs

After selecting the menu item „TRANSFORM | BATCH PROCESSING...“ the dialog „Edit job list“ is opened. Via the pop-up menu „FILE“, existing batch projects can be loaded (menu item „FILE | OPEN...“) or also saved (menu items „FILE | SAVE“ and „FILE | SAVE AS...“).

New conversion jobs can be inserted via the menu item „EDIT | NEW JOB...“ or via the context menu of the right-hand mouse button. The dialog „NEW JOB...“ is opened where the source file (TTR – ray file), the target format, and an optional comment can be selected.

Afterwards, the parameters available for the target format chosen are displayed in the dialog section „PARAMETER – CONVERSION“. Here, also the target file is indicated.

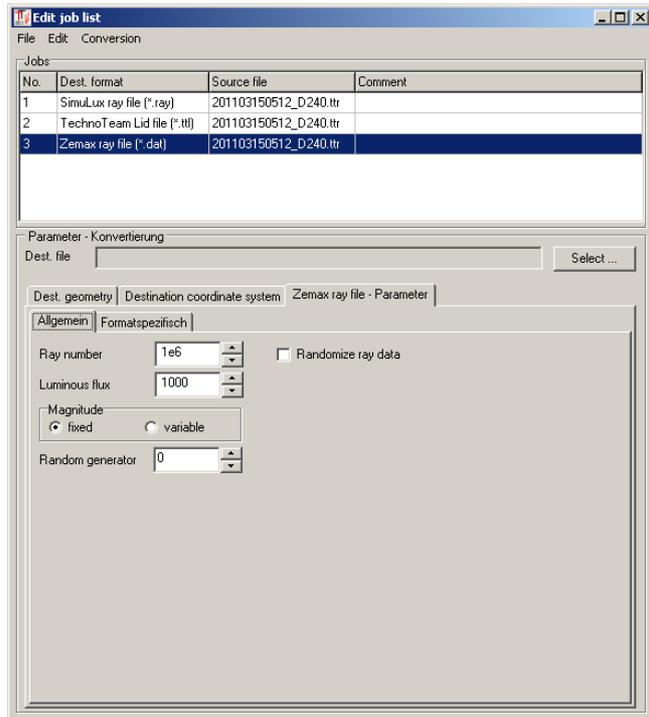
For a new entry, the parameters of the current entry in the list are adopted.



The indication of the target coordinate axes has already been explained in Chapter 3.3.1, „Conversion of the coordinate system“, and the indication of the target geometry for the starting points of the rays is given in Chapter 3.3.2 „Starting points of the rays“. During batch processing, however, the parameters are not taken from the central application configuration, but from the data contained in the batch processing file!

The input parameters for the various ray data formats are explained in the corresponding paragraphs of Chapters 4 and 5. In addition, there is the option „RANDOMIZE RAY DATA“, by means of which a random rearrangement of the rays in the target file can be effected (cf. Chapter 6.1, „Randomize rays“).

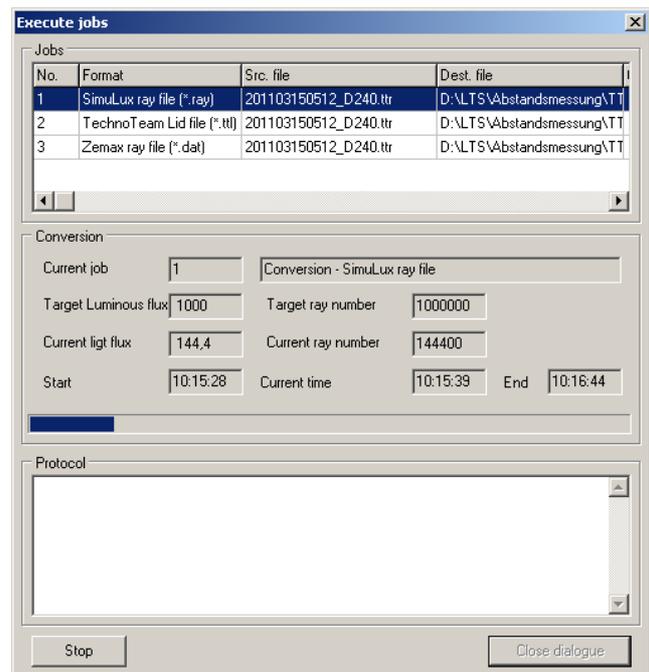
The batch processing parameters are saved in an ASCII – file (for details see chapter 3.4.3, „File structure of batch processing file“).



3.4.2 Executing jobs

Batch projects can be executed via the menu item „CONVERSION | START...“. In the dialog „Execute jobs“ the current conversion parameters just as the conversion progress are displayed during job execution.

For each ray file, a protocol file is generated in the ASCII – format which contains all conversion parameters and results. The file name of the protocol file is composed of the name of the current target file, the file extension „.ext“ and the postfix „.log“ in the following way: „Name of job_ext_log.txt“.



Example protocol:

<pre>Ray data conversion ===== Job - file: D:\tmp\unnamed.rcj Job - Number: 1 Source file: D:\M1434_cam_sphere_2_500x2_500.ttr Target format: ASAP ray file (*.dis) Target file: D:\tmp\test2.dis Comment: Light flux - source file: 274.58 Number of rays - source file: 242600153 Parameters - target geometry ----- Targe geometry: cylinder Length: 1.500000e-01 Radius: 5.000000e-02 Rot-X: 0.000000e+00 Rot-Y: -9.000000e+01 Rot-Z: 0.000000e+00 Tx: 0.000000e+00 Ty: 0.000000e+00 Tz: 0.000000e+00 Vx: 0.000000e+00 Vy: 0.000000e+00 Vz: 1.000000e+00</pre>	<pre>Parameters - axes ----- Basis vector X: 1 0 0 Basis vector Y: 0 0 1 Basis vector Z: 0 -1 0 Parameters - conversion ----- Starting value: 0 Target light flux: 274.58 lm Number of rays: 1000000 Title: Amplitude: fixed Unit of length: mm Randomize rays: no Results - conversion ----- Starting time: 18:01:05 End time: 18:02:18 Portion - light flux: 99.35 % Portion - number of rays: 99.35 %</pre>
--	---

3.4.3 File structure of batch processing file

Batch processing files are saved as ASCII-files (*.rcj – RiGO–Converter–Job) in the INI-file – format. In the following, the file structure is described in great detail so as to allow manual modifications or also the setting up of a job file by means of a text editor.

The following conventions must be respected:

- The entry must be single-spaced.
- All terms given in square brackets are denominated as sections.
- Variables are declared with a name, a subsequent equality sign and the value.
- Blank lines are permitted.
- Comments must be given in an extra line and should be started with a non-ambiguous sign, such as *,//* or *,#*

The batch processing file below shows an example of the sections, variables and comments:

```
# File header
[Converter job]
# Number of job entries
Number=3

# Section for first job, base parameters
[Job1/BaseParam]
# Format: 1 -> Technoteam - Lvk (*.ttl), 2 -> ASAP (*.dis),
#         4 -> ERF (*.erf), 8 -> HELLA (*.rwr), 16 -> LucidShape (*.ray),
#         32 -> LightTools (*.txt), 64 -> Zemax (*.dat),
#         128 -> TracePro (*.src), 256 -> Speos (*.ray),
#         512 -> SimuLux (*.ray)
Format=2
# Source file
SourceFile=C:\RiGO-measurements\D2\D2R_Philips_35W_25x25.ttr
# Remark
Remark=
```

```

# Start - parameters for job 1
[Job1]
# Target file
TargetFile=C:\tmp\test.dis

# Parameters - Target geometry (Raytracer)
[Job1/GeometryParam/RayTracer]
# ID - Name of raytracer
Id=TTCylinder
# Parameters of raytracer
[Job1/GeometryParam/RayTracer/Param]
fLength=1.500000e-01
fRadius=5.000000e-02
fRotX=0.000000e+00
fRotY=-9.000000e+01
fRotZ=0.000000e+00
fTx=0.000000e+00
fTy=0.000000e+00
fTz=0.000000e+00
fVX=0.000000e+00
fVY=0.000000e+00
fVZ=1.000000e+00
lMode=1
lUnit=0

# Orientation of target coordinate system
[Job1/PermuteAxisParam]
# Base vectors (unit vectors) for X- and Y-axes.
# Z - axis results from cross product
BaseVectorX=1 0 0
BaseVectorY=0 1 0

# Parameters of target format. For the sake of completeness, the sections of
all formats are enlisted. However, only the ASAP parameters would be necessary
here.

# ASAP parameters
[Job1/AsapParam]
# Starting value
StartValue=0
# Number of rays
RayCount=1000000
# Amplitude mode: 0 -> fixed, 1 -> variable
AmplitudeMode=0
# Unit of length: 0 -> mm, 1 -> cm, 2 -> inch, 3 -> m
Unit=0
# Target luminous flux [lm]
LuminousFlux=2.876901e+03
# Title
Title=

# Speos - ERF parameters
[Job1/ERFParam]
# Starting value
StartValue=0
# Number of blocks
BlockCount=1
# Number of rays - Block 1, if BlockCount > 2, continue with RayCount2, ...
RayCount1=1000000
# Amplitude mode: 0 -> fixed, 1 -> variable
AmplitudeMode=0
# Unit of length: 0 -> mm, 1 -> cm, 2 -> inch, 3 -> m
Unit=0
# Target luminous flux [lm]
LuminousFlux=2.876901e+03
# Comment
Comment=

```

```
# Flag, if - after conversion - another file with randomized rays shall be
generated
RandomSwap=0

# Hella - RWR - parameters
[Job1/RWRParam]
# Starting value
StartValue=0
# Number of blocks
BlockCount=1
# Number of rays/blocks
BlockSize=1000000
# Target luminous flux [lm]
LuminousFlux=2.876901e+03
# Comment
Comment=

# Technoteam - LVK (TTL) - parameters
[Job1/TTLParam]
# Angular step width - C - levels [°]
Dc=2.500000e+00
# Angular step width luminous intensities [°]
Dg=2.500000e+00

# Continue with parameter for second and third job
[Job2/BaseParam]
.
.
.
```

4 Generating luminous intensity distributions

4.1 Generating TechnoTeam-Lvk (*.ttl) from *.ttr-file

In the program **Rigo801** – regardless of whether a ray file shall be additionally saved or not – a corresponding luminous intensity distribution (file ending *.ttl) is calculated during each measurement. In doing so, the coordinate system of the goniometer and the angular resolution of the measurement are automatically used for determining the C-levels and the distance of the luminous intensities within the C-levels.

The format of the TechnoTeam-luminous intensity distributions (*.ttl) has already been described in the Chapter „Rigo801 File formats,, of the „ Rigo Measurement Manual“.

Using the program **Converter801** it is possible to generate luminous intensity distributions with other parameters from the ray file at a later time:

- By applying the menu item „OPTIONS | TARGET GEOMETRY“, a conversion of the goniometer coordinate system is effected before a TTL-conversion
- Other angular resolutions between and within the C-levels can be set.
- The Lvk (luminous intensity distribution curve) can optionally be smoothed.

The dialog for calculating a luminous intensity distribution from a ray data record can be accessed via the menu item „TRANSFORM | TECHNOTEAM LUMINOUS INTENSITY DISTRIBUTION (*.TTL)...“. In the section „DC“ the distance between two C-levels can be set. In the field „DG“ the distance between the luminous intensities within a C-level can be chosen. From these two entries, the number of the C-levels „MC“ and the number of the luminous intensities for each C-level „NG“ are calculated automatically.

If necessary, the luminous intensity distribution can be smoothed after calculation (selection box „LID-SMOOTHING“). The filter widths for the smoothing filter can be fixed by the user via the fields „CONVOLUTION WIDTH PHI“ and „CONVOLUTION WIDTH THETA“. The filter widths indicate the filter size in the form of the number of Lvk-cells at the

equator of the spherical coordinate system.

After pressing the button „START“, a file selection dialog is opened where the name of the target file can be entered. Afterwards, the conversion process is initiated.

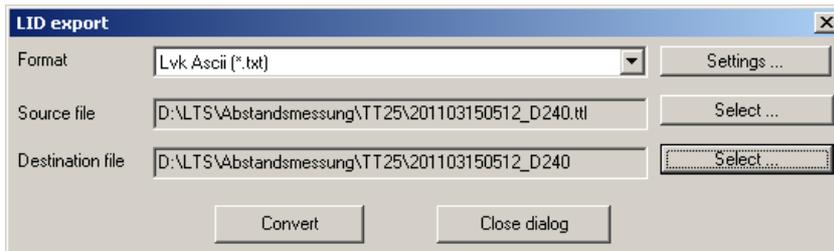
By pressing the button „CANCEL“ a conversion process already started can be terminated ahead of time.

When calculating a luminous distribution anew, it is possible to work with an angular resolution which is smaller than the one used for measurement. In many cases, the number measuring errors increases considerably. The reason for this is that each luminous intensity value of the distribution is calculated from a number of rays which is distinctly smaller than that in the originally generated distribution. If, for example, the luminous intensity distribution is calculated anew with an angular resolution of 0.5° from a 2.5°-measurement,

then each newly calculated luminous intensity value is based on a number of rays which – on average - is 25 times smaller than the values occurring in the original distribution.

4.2 Lvk-export from *.ttl-file

Via the menu item „TRANSFORM | LID EXPORT FROM TTL-FILE...“ the luminous intensity distribution can be converted by the Technoteam TTL – format into various output formats. Each output format is implemented by an own DLL – library. These use an open API – interface (documentation upon request). Thus, it is also possible to realize customized output formats without changing the main program.

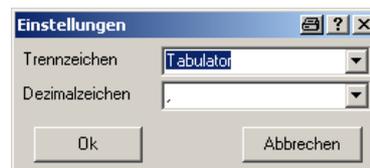
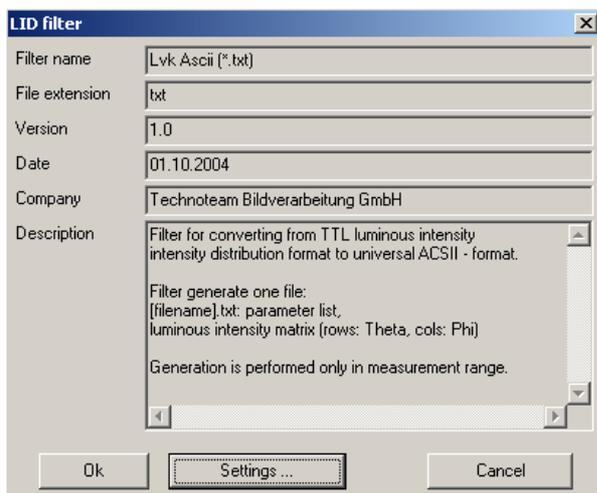


In the selection list „FORMAT“ of the dialog „LID EXPORT“, all available export formats are listed. By pressing the button „SETTINGS ...“ a dialog is opened, which supplies information about the chosen export format. Here, a parameterization of the export format chosen is possible, too.

All presently available output formats are described below.

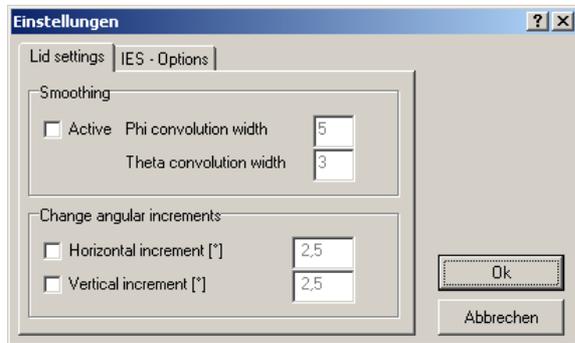
4.2.1 Export format Ascii (*.txt)

The Ascii-export format constitutes a universal ASCII – format which contains the entries of the TTL-file in a readable form. The output of the luminous intensity matrix (rows: theta, columns: phi, first row: phi angle, first column: theta angle) is effected only for the measured angular range.

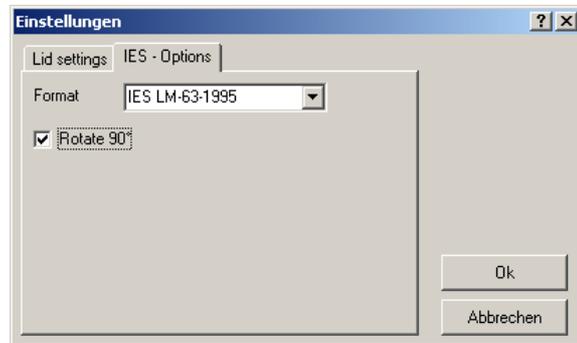


4.2.2 Export format IES (*.ies)

The IES-format is the synonym for several downwards-compatible formats – defined by the Illuminating Engineering Society – for photometric data and the information pertaining to them. The format generated here orients itself towards the IES LM-63-02 standard. In this format, the luminous intensity is not normalized, but it is contained as absolute luminous intensity.



In the tab window „LID SETTINGS“ optional smoothing and also an optional modification of the measuring grid can be set.



In the tab window „IES-OPTIONS“ the format specification can be set in the combobox „FORMAT“ and – via the selection box „ROTATE 90°“ – the rotation of the C-levels by 90° (compatible with the Anglo-American standard).

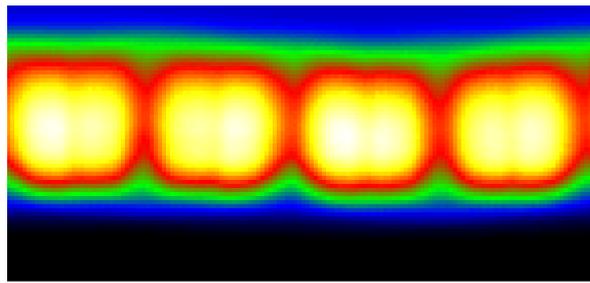
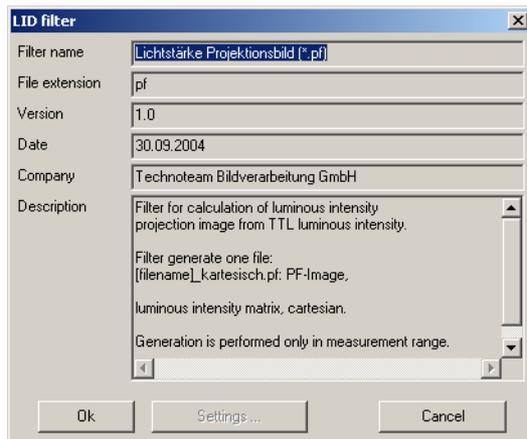
4.2.3 Export format LDT (Eulumdat)

EULUMDAT is a format for exchanging photometric data concerning the luminous intensity distribution of light sources dating from the year 1990. The typical file ending is *.ldt. In continental Europe, this format has become the industrial standard for conveying photometric data. Here, the Lvk-values are contained as cd/klm – normalized values without digits after the decimal point. As the format does not support any test lamps but only the single lamps contained in a luminaire, the test lamps contained in the ttl-file are combined to form a virtual lamp by summing up the luminous flux. If no measuring lamp is available (number of test lamps = 0), a virtual lamp („testlamp“) is specified as lamp with a measured luminous flux equal to the luminous flux of the luminaire (operating efficiency ratio of the luminaire 100%).

Similarly to the IES export format, it is possible to set in the tab window „LID-SETTINGS“ optional smoothing and also an optional modification of the measuring grid.

4.2.4 Luminous intensity of projection image (*.pf)

The export filter projection image of luminous intensity generates an image projection of the absolute luminous intensity matrix in the PF – format (Picture Float, readable by means of LMK Labsoft – software). The output is effected in the full-sphere angular range. The image columns correspond to the C-levels, the image lines correspond to the γ -levels of the luminous intensity distribution.



Example of a projection image

5 Generating ray files

5.1 ASAP-ray files (*.dis)

5.1.1 Structure of ASAP-ray files

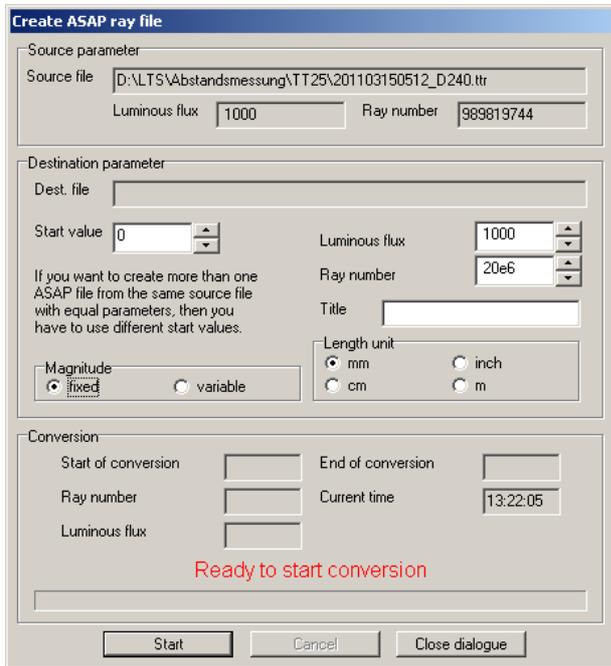
The ASAP-file format can be utilized for a big variety of tasks. In general, it consists of consecutive data records of identical length, but possibly different importance. The files generated by the TechnoTeam company present the following structure:

- Each data record has a length of 28 bytes.
- The file header in front of the actual ray data consists of 5 data records.
- Afterwards, the ray data are arranged.

Data record	Contents
1	4 byte, integer: 247+1024*number of rays
	24 bytes: not utilized
2	24 bytes, string: Title. Bytes not utilized are filled up with a blank. The string does not end with zero.
	4 bytes, integer: 7 (number of data per ray – see below)
3	8 bytes, string: „Tot Flux“
	4 bytes, float: total luminous flux (sum of the amplitudes of all rays)
	16 bytes, string: e.g. = "XYZABCF MM ". The first 7 signs denote the ray data format: 3 coordinates of the initial points of the ray, 3 ray directions, amplitude. „MM“ stands for millimeter, i.e. the unit in which the initial points of the rays are indicated. Further possibilities are: „M“ = meter, „CM“ = centimeter, „INCH“ = Inch, 1 Inch = 25.4 mm
4	16 bytes, string: "Ray number "
	4 bytes, Float: 1.0
	4 bytes, Float: number of rays
	4 bytes, Integer: -number of rays
5	16 bytes, string: "Wavelength "
	4 bytes, Float: 0.0
	4 bytes, Float: 0.0
	4 bytes, Integer: -1
6	First ray data record:
	4 bytes, Float: x-coordinate of the initial point of the ray
	4 bytes, Float: y-coordinate of the initial point of the ray
	4 bytes, Float: z-coordinate of the initial point of the ray
	4 bytes, Float: x-component of ray direction
	4 bytes, Float: y-component of ray direction
	4 bytes, Float: z-component of ray direction
4 bytes, Float: amplitude (light flux portion) of ray	
...	Number of rays - 1 further ray data records

5.1.2 Generating ASAP-ray file from *.ttr-file

Selecting the menu item „TRANSFORM | ASAP RAY FILE (*.DIS)...“ opens the dialog „CREATE ASAP RAY FILE“.



The dialog section „SOURCE PARAMETER“ displays some essential information concerning the ray file loaded before via the menu item „FILE | OPEN...“.

Before conversion is effected, some parameters can be fixed in the dialog section „TARGET PARAMETER“.

In the field „RAY NUMBER“, the number of rays to be generated can be entered.

Using the field „LUMINOUS FLUX“, the total luminous flux of all rays in the output file can be fixed, which might differ from that of the source luminous flux.

In the field „TITLE“, a text comprising 24 characters can be entered which will then be included in the ray file.

In the dialog section „MAGNITUDE“, the user can fix whether all rays shall have identical or different amplitudes. In doing so, however, the file size is not changed as the ASAP-format does not specially support the unity ray mode.

In the dialog section „LENGTH UNIT“ the user can fix the unit in which the starting points of the rays shall be output.

The conversion of the TechnoTeam-rays into ASAP-rays represents a well-determined algorithm. This means that a second conversion will yield the same ray data, with the parameters being identical. In order to generate from a TechnoTeam-ray data record a second record which is independent of the first one (other ray selection and order), a modification can be made in the field „START VALUE“.

Upon pressing the button „START“ first the file name of the target file is queried before conversion is started. In the dialog section „CONVERSION“ the user can follow the progress of conversion. Not only are the starting time, the current and the estimated end time displayed, but also the number of the rays generated as well as their luminous flux.

If the number of rays or also the corresponding luminous flux are considerably smaller than the values preset in the dialog section „TARGET PARAMETER“, this may indicate that the light exit body has either been chosen too small or wrongly positioned (cf. menu items „OPTIONS | TARGET GEOMETRY...“ or also „OPTIONS | TARGET COORDINATE SYSTEM...“). The cause of this is that the raytracing of rays from the position of the camera to the surface of the light exit body does often not reach the body. These rays which cannot be utilized in such a case will be dismissed by the program.

5.1.3 Converting ASAP-ray file into ASCII-file

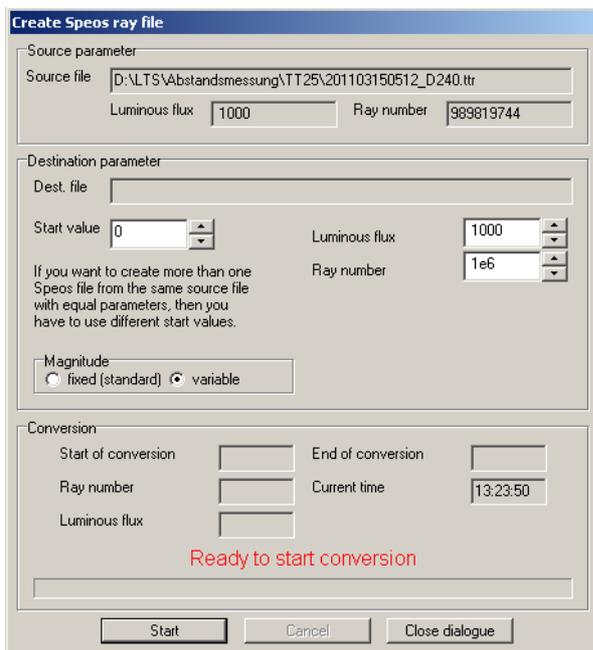
Using the menu item „TRANSFORM | ASAP (*.DIS) → ASCII (*.TXT)...“ an existing ASAP-file can be converted into an ASCII-file. This function is advantageous mainly for developers for debugging who wish to import the ASAP-files into their own programs. When selecting the menu item, the name of the ASAP-source file and that of the ASCII-target file will be queried. Afterwards, the user is asked whether also the rays themselves shall be included in the ASCII-file. Otherwise, the ASCII-file only contains the header information of the ASAP-file.

Example of an ASCII-file generated:

```
Record1: ASAP-ray file with 4 * 7 = 28 Bytes je Record
Record2: " " " 7
Record3: "Tot FLUX" 3.035e+02 "XYZABCF MM "
Record4: "Ray Number " 1.000e+00 1.000e+04 -10000
Record5: "Wavelength " 0.000e+00 0.000e+00 -1
Record6 and following ones:
 X Y Z A B C F
 2.476e+02 3.767e-03 -1.325e+02 8.249e-01 4.725e-02 -5.634e-01 1.978e-02
 2.476e+02 3.767e-03 -1.325e+02 8.968e-01 -5.615e-02 -4.389e-01 1.978e-02
 . . . .
-2.486e+02 1.086e+01 -1.302e+02 -7.625e-01 4.494e-02 -6.454e-01 4.506e-04
-2.486e+02 1.086e+01 -1.302e+02 -8.242e-01 2.087e-01 -5.265e-01 4.506e-04
-2.486e+02 1.086e+01 -1.302e+02 -9.263e-01 4.624e-02 -3.738e-01 4.506e-04
End of file reached
```

5.2 Generating Speos ray file (*.ray) from *.ttr-file

Selecting the menu item „TRANSFORM | SPEOS RAY FILE (*.RAY)...“ opens the dialog Speos-ray file.



Similarly to the dialog „CREATE ASAP RAY FILE“, some essential information concerning the ray file loaded is displayed in the dialog section „SOURCE PARAMETER“.

In the dialog section „TARGET PARAMETER“, a number of parameters can be fixed before conversion.

In the field „RAY NUMBER“ the number of rays to be generated can be entered.

Using the field „LUMINOUS FLUX“ the total luminous flux of all rays can be preset in the output file, which might differ from the value of the source luminous flux.

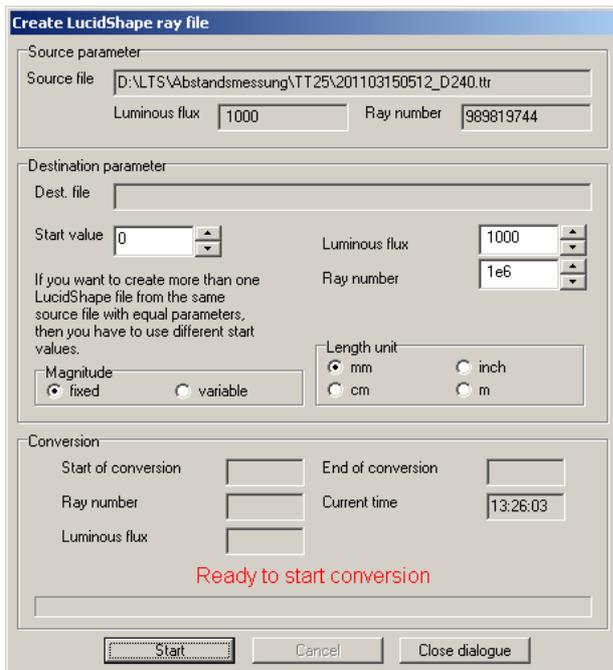
In the dialog section „MAGNITUDE“ the user can choose whether all rays shall have identical or different amplitudes. This, however, does not influence the size of the file.

The algorithm for selecting rays from the file is well-determined. This means that a second conversion will yield the same ray data, with the parameters being identical. Wanting to

generate several independent RAY-ray files from a TTR-file, the user can generate different files by presetting different starting values each time.

By pressing the „START“ button, conversion is started. For this, first the name of the target file must be fixed in a file selection dialog, then conversion is started. Pressing the „CANCEL“ button can stop an already running conversion process.

5.3 Generating a LucidShape ray file (*.ray) from a *.ttr-file



Via the menu item „TRANSFORM | LUCIDSHAPE RAY FILE (*.RAY)...“ the dialog for generating LucidShape – ray files is activated. The function mode of this dialog is identical to the ASAP-dialog (cf. Chapter 0, Generating an ASAP-ray file from a *.ttr-file“), except for a missing title or comment which cannot be included in the file.

5.4 Generating LightTools ray files (*.txt) from a *.ttr-file

Via the menu item „TRANSFORM | LIGHTTOOLS RAY FILE (*.TXT)...“ the dialog for generating LightTools – ray files is activated. The function of this dialog is identical to the ASAP – dialog (cf. Chapter 5.1.2 „Generating ASAP-ray file from *.ttr-file“).

Please note that the LightTools – ray files are output in the ASCII – format, which may result in very large files.

5.5 Generating a Zemax ray file (*.dat) from a *.ttr-file

Via the menu item „TRANSFORM | ZEMAX RAY FILE (*.DAT)...“ the dialog for generating LightTools – ray files is activated. The function mode of this dialog is identical to the ASAP – dialog (cf. Chapter 5.1.2 „Generating ASAP-ray file from *.ttr-file“).

5.6 Generating a TracePro ray file (*.src) from a *.ttr-file

Via the menu item „TRANSFORM | TRACEPRO RAY FILE (*.SRC)...“ the dialog for generating TracePro – ray files. The function mode of this dialog is identical to the ASAP – dialog (cf. Chapter 5.1.2 „Generating ASAP-ray file from *.ttr-file“).

5.7 Generating a SimuLux ray file (*.ray) from a *.ttr-file

Via the menu item „TRANSFORM | SIMULUX RAY FILE (*.RAY)...“ the dialog for generating SimuLux – ray files is activated. The function mode of this dialog is identical to the ASAP – dialog (cf. Chapter 5.1.2 „Generating ASAP-ray file from *.ttr-file“).

6 Other conversion features

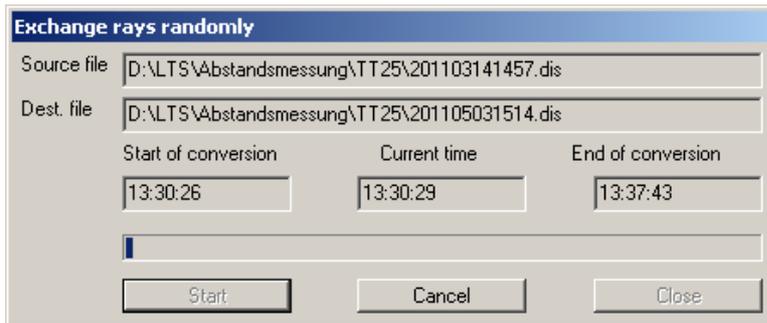
6.1 Exchanging rays randomly

At first, the ray data are output in the order in which they are recorded during measurement. In the *.ttr – file, closely neighboring ray data result from neighboring camera positions when the cameras are moved, and, therefore, have similar directions.

Simulation programs often read in ray files sequentially and allow the user to abort simulation ahead of time. In the case of sequential ray data, however, the simulation result is not representative for the total amount of rays.

If the calculation result obtained after the early abort of the calculation process shall largely correspond with the result of the complete calculation (with slightly inferior accuracy), then the rays in a file must be arranged randomly, i.e. it must not be possible to draw - from the position of a ray in the file - a statistically significant conclusion concerning the place of capture or also the direction of the rays.

Via the menu item „TRANSFORM | EXCHANGE RAYS RANDOMLY...“ it is possible to generate from an already existing ray file at a later time a new ray file in which the rays are arranged randomly. When selecting this menu item, the dialog „EXCHANGE RAYS RAMDOMLY“ is opened.



When pressing the „START“ button in the dialog, the name of the source file and also the name of the target file are queried before conversion starts. Using the „CANCEL“ button, an already running conversion process can be stopped ahead of time. When conversion is finished, the dialog can be quitted by pressing the „CLOSE“ button.