These release notes are describing changes in LIMES 2000 since version 18.1117.1038. The new release 20.0403.1117 integrates a number of new features and urgent bug fixes within different application areas. Most of them have been already available within the 19.0816.1090 prelease version but have been further refined since August 2019.

Additional features are in the queue and currently under test. They will be published as a major release later in 2020, but may be made available again on request as a pre-release.

The new release is not covering the GO-R series of LMT goniophotometers and can only be applied to laboratories with GO-H, GO-DS, GO-FI and GO-V machines!

An enhanced update of LIMES 2000 for GO-R goniophotometer control will be part of the next release which is (as outlined above) scheduled later in 2020.

Installation

LMTAO version 1.2.152 or higher is required for LIMES 2000 rev. 20.0403.1117. If the LMTAO library is not installed or shows an outdated version, Limes and LimesControl will not start. LMTAO is available for download on the LMT homepage.

LMT has installed a check of the software version as well with regard to the spectrometer software. The interface between LimesControl and the spectrometer service is permanently improved and new features can only be offered, if both software packages are up-to-date.

LIMES 2000 version 20.0403.1117 requires LMT spectrometer software 1.9.2.7401 or later to be installed.

In case a goniometer laboratory contains a spectrometer and the version of the spectrometer software does not fit, LIMES 2000, respectively, LimesControl will not execute any measurement commands using the spectrometer!

Instead, LimesControl will issue a message that an outdated version of the service is installed, but will of course execute all measurement commands which do not use the spectrometer.

New features

The latest release of Limes 2000 offers a new evaluation called LucidShapeLite for LMT (LSL4LMT) which can be called via the corresponding menu item. More details are outlined in the chapter below.
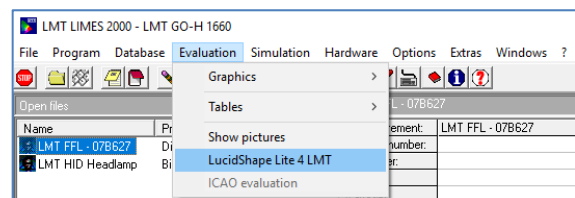

LucidShapeLite for LMT

LSL4LMT is intended for extended analysis of automotive lighting devices. It is a derivate of the well-known LucidShape simulation tool and offers an easy path from measured LMT goniophotometric data into virtual reality tools.

LSL4LMT must be enabled within the individual *.udb-file and is only accessible, if LSL4LMT is installed. Measured grid data are transferred from Limes 2000 to LSL4LMT via a special tab in the evaluation menu (see screenshot above).

As usual in Limes 2000, the measurement of interest must be highlighted in the file list. The LSL4LMT option will be active only for data sets containing at least one luminous intensity distribution.

If the button is checked, LSL4LMT will be opened and the distribution is displayed in LSL4LMT (see diagram on the right-hand side). In case the program is already running, data will be transferred into the active LSL4LMT window.

If test data are selected which contain more than one distribution, a dialog will pop up in which the user has to select the distribution.
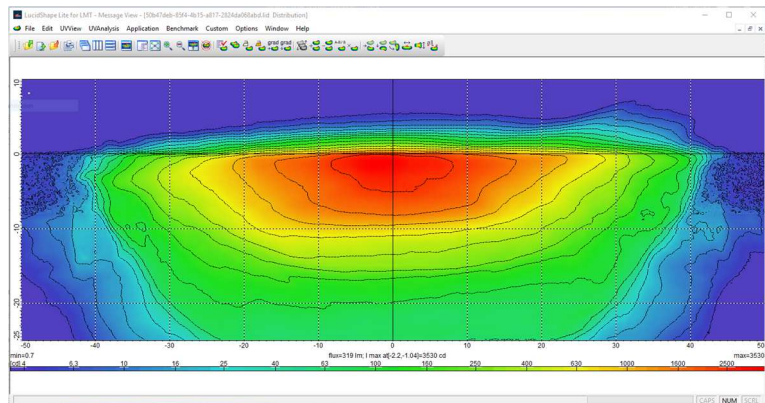
Database management

When exporting data from one database to another database, the user may wish to delete the test data in the source database. In case a test program is not anymore used by other sets of test data in this database, a dialogue comes up and the user is requested to confirm or cancel, whether the program shall be deleted, too.

Unfortunately, this procedure requires the user to confirm the preferred action for each test program which can be sometimes very time-consuming. Therefore, a checkbox was added to the export window which allows to skip above mentioned dialogue. In this case unused test programs will be always kept in the old database.

Performance of loading measurements with spectral data has been optimized with regard to loading time and memory usage.

General Lighting

The message box which is being created during pole correction has been changed.

- If the limits for both γ = 0° and for γ = 180° were violated, the user got two individual messages. Now Limes 2000 will issue only one message box with all relevant information.

- In addition, henceforth it is possible to choose correction only at γ = 0° and/or at γ = 180°. This feature is helpful if data are exported (for example as *.ldt) and the import program accepts only light distributions having for each C-plane identical values at γ = 0° and/or at γ = 180°.

Since the effect of pole correction is not fool-proof and strongly depends on the measured intensity, by default Limes 2000 is set up to do this only within safe limits.

The individual user may change those limits, but will get a warning message if the chosen limits are smaller than the default values. Pole correction based on low intensities is not considered to deliver robust results and always bears the risk of transferring noise from the pole into the overall distribution.

Further changes for application General Lighting:

- The LOR value in the sample header and in the TM5 report was not updated after correction to maximum. The difference of LOR based on corrected or uncorrected data depends of course on the magnitude of the correction. The bug was fixed for both LMT and user-defined reports.

- The UGR table was initially introduced within the framework of relative photometry, e.g. luminaire flux was calculated based on nominal lamp flux. In case of absolute photometry measurements, the user had to enter in the past the luminaire flux into the entry for lamp flux to get correct UGR values.
The new LIMES 2000 release will calculate the UGR table for absolute photometry directly from the integrated luminaire flux.

- The integration test in LimesControl (see right-hand side) is not anymore limited in speed but allows all speeds for both C and γ, starting with 1.
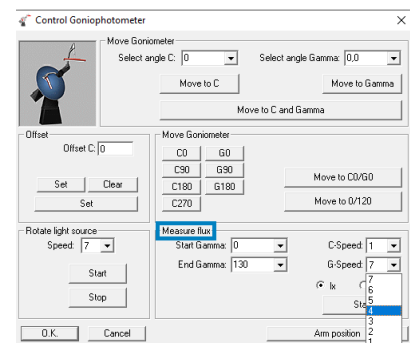
IES LM-79:2019

In the latest version of LM 79 a few changes have been introduced with regard to determination of colour uniformity in chapter 9.

1. The simplified algorithm for integrated chromaticity presented in IES LM-79:2008 shall not be used anymore. Since LIMES 2000 has been always using the "exact" method based on tristimulus values *X, Y, Z,* this change is of no concern.

2. Similar to IES LM-79:2008, the calculation of angular colour uniformity requires that "*data in angular regions for which the luminous intensity is less than 10% of the peak intensity Y_p shall not be included in the calculation of angular color uniformity*".
Therefore, the 10% limit is still active.

3. However, the corresponding formula for colour uniformity

$$\Delta_{u',v'} = \max_{\substack{(u',v') \mid \\ Y \geq 10\% \text{ of } Y_p}} \left(\sqrt{(u' - u'_a)^2 + (v' - u'_a)^2} \right)$$

refers to the angularly averaged chromaticity coordinate (u'_a, v'_a) which is "*calculated from goniometric data measured over the angular range of interest*". This range may include as well data points having less than 10% of the maximum intensity.

Therefore, in future LIMES 2000 will determine (u'_a, v'_a) for LM-79 evaluations from all data points having a sufficient intensity to deliver a valid chromaticity reading, e.g. one which is above the noise level.

In order to distinguish a valid chromaticity reading from measurement noise, the communication between LIMES 2000 and the spectrometer service has been updated. Each spectrum transferred to LimesControl now carries a "tag" describing its validity.

The "valid tag" takes as well care of the requirements in LM-79:2019 (clause 9.5) regarding establishing a luminous intensity limit for the measurement or chromaticity uniformity. Of course, this parameter depends on the specific type of spectrometer, measurement distance etc. and has to be determined individually for each laboratory.

Interaction with spectrometer software

Obviously, the changes in LM-79:2019 evaluation require that the spectrometer service is up-to-date. Therefore, please refer as well to the installation remarks made on the first page.

After start, LimesControl will check whether an LMT spectrometer is available and if this is the case, whether an up-to-date spectrometer service is installed. If the check shows that the spectrometer software is outdated, LimesControl will inform the user that spectrometer measurements cannot be performed. In order to support the user with the update, the download link to the required installer package will be copied to the clipboard. LimesControl will continue to start latest after 20s.

As long as the required spectrometer service version is not available, all measurement commands using the spectrometer will be changed by LimesControl into text lines. In case a measurement is saved, the name of the modified test program will get the appendix *(Mod.)*.

A similar procedure is performed if a spectrometer is the active device in an integrating sphere application.

Measurements made with an earlier version of LIMES 2000 and the corresponding spectrometer software will not be affected.

Report layout

- The edit layout functionality has been improved to allow for creating header layouts longer than one page, for instance to build a first page with more information and use a smaller header for the following pages. This was done having in mind requirements from CIE S025.

- TM30 evaluation is available as a table in screen view and can be printed or saved as csv file. TM30 Values will be stored for each measured spectrum. The TM30 value for the summed spectrum is as well part of the table.
  TM30 is only available if the spectrometer client version is up-to-date. Please note the corresponding remarks within the chapter installation.

- Purity will be calculated for the summed spectrum and can be chosen as a field within the sample header. 3 additional parameters are also available as new entries in the sample header:
  – Average CRI, e.g. R_a

- Average CCT
- Integrated radiant flux

Automotive lighting

- The gradient command within ECE test programs for license plate measurements has been corrected because the tolerance limit evaluation was not properly implemented.
  In the past, the entry of the upper limit was interpreted as a number (usually set to 2.0) while now it is being used as a factor (according to UN reg. 4, Annex 7), which is multiplied with the lowest luminance value out of the grid. This is done similarly for factors F1, F2 and F3.

- Within AFS evaluation there was an issue when the maximum check was performed on the averaged light distribution. The command delivers as results both the maximum and the minimum value of the averaged light distribution, but only the maximum must be compared to the upper and lower limit. However, within the AFS evaluation branch the minimum was compared to the lower limit. This has been corrected.
  The standard maximum measurement command was not affected by this bug.

- If during preparation of the test report the checkbox *Show grid without re-aim* was activated, the columns were not printed properly. The bug was fixed.

- Linearity evaluation of the cut-off so far was done by comparing the maximum deviation from the chosen cut-off with the given tolerance window. However, the choice of the cut-off (Default, Min, Max or Average) was influencing the result.
  In future, the user can explicitly change the check in such a way that the difference between the highest and lowest offset position is compared to the linearity requirement (see window on the right-hand side).


- The dialogue for visual aiming now allows choosing the photometer time constant (e.g. slow/fast) in case the goniophotometer is equipped with AMR heads.
  However, in case "actual head" is chosen as photometer, the AMR setting of the measurement will be used and in the AMR frame the text "Set by test function" is shown.

- The scan speed within cut-off measurements (Visual Aiming) can now be set different for vertical and horizontal line scan. Since the pre-defined horizontal scan speeds in LMT goniophotometers are much higher than the vertical ones, this feature becomes necessary with the increased need for horizontal aiming, especially in combination with pulse-width modulated signals.
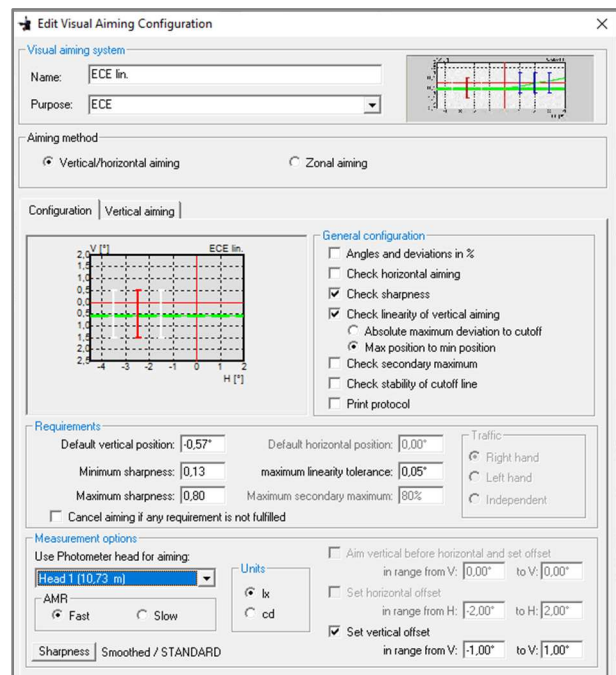
- The sharpness calculation according to the formula of Pollack was giving incorrect results (too high) if the algorithm was fed with candela. Different from other evaluations the Pollack formula expects illuminance as measured on the observation screen. The bug was fixed.

- When performing "check stability of cut-off line" within the visual aiming options, incorrect values were given if the "actual" photometer head was not positioned at HV (which is usually the case for head I). The first visual aiming procedure was done correctly, but from the second scan on the offset of the actual head was ignored. The bug was fixed.

- Check stability of cut-off line is intended to be used within an aiming program with only one vertical cut-off. In this case the stability diagram and all single cross sections made during the stability check are shown in the aiming diagram.

- The 6-channel PWM multiplexer available in GO-H 1660 systems can now be configured and used within Limes 2000. The corresponding dialogue for configuration can be found via Options→Hardware, however, the feature must be enabled in advance in the user database file (*.udb).

  Duty cycle and frequency can be set within the measurements via the "Test" tab. The dialogue in →Hardware →Power Supply and the corresponding one in LimesControl have been extended by this feature.
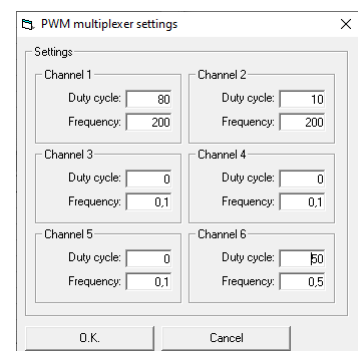
  If a goniophotometer is equipped with a multiplexer having PWM switching functionality, this feature may be used as well for realising the blinking mode.

Measurement of degradation factor

During introduction of the degradation factor within the stabilization routine, the factor was saved as a lamp parameter. However, if several measurements were done with the same lamp and the degradation factor was changing between the individual measurements, the latest value has been applied to all measurements.

With the new release the degradation factor will be always stored in the test data. Each measurement has now an individual degradation factor which will not be changed anymore when performing another measurement with the same lamp.

If a degradation factor has been determined during stabilization, the factor will be shown in in the EditData dialogue of the lamp which has been used.

It is also possible to display the degradation factor in the report header. A field entry has been added to LIMES 2000 which can be used when editing the sample header.

Flash measurements

In advance of the new LIMES 2000 version, the release 1.2.1 of SoLiT *Flash* has been published. Due to further improvements, as of today version 1.2.2 is already available.

The communication protocol between SoLiT *Flash* and Limes 2000 was expanded by *Peak Intensity* and *Optical Power* (= flash energy multiplied by number of flashes per minute).
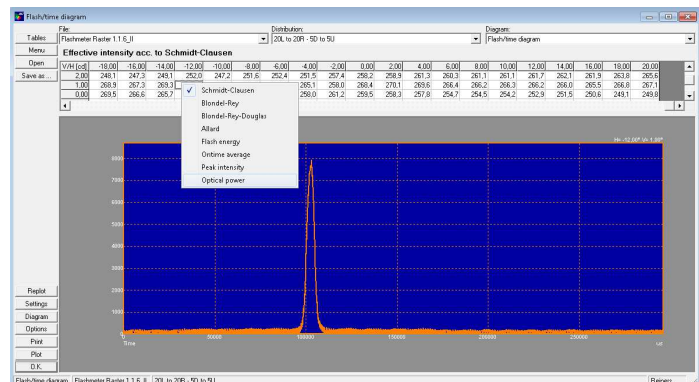
Therefore, these parameters are now available in the evaluation menu of Limes 2000 (see picture above) in addition to the standard algorithms (Form-factor = Schmidt-Clausen, Blondel-Rey-Douglas, Allard and flash energy). Within the context of the menu a minor bug was fixed with regard to properly displaying the flash/time diagram.

In the table displayed on top of the flash time diagram, the unit of displayed data is shown within the table cell in the upper left corner, e.g. V/H [cd], V/H [cd·s] or V/H [cd·s]/min].

Power supplies and power measurement

- Since introduction of harmonics analysis in general lighting applications, U_{THD} and I_{THD} data cells have been shown even if there was no electrical instrument like the YOKOGAWA WT3000 G6 to read these data. In future these cells will be visible only if valid THD data are available.

- A similar bug was introduced for DC driven DUTs where cells for power factor or frequency were displayed. The bug was fixed.

- The Yokogawa WT1800 with option G5 has been added to the list of power measurement devices. The option G5 allows as well the readout of harmonic values (THD).

- The Yokogawa WT5000 has been added as well. This device offers harmonic evaluation already in the standard version.

- In addition to IEEE-488, the TCP/IP interface of TDK Lambda Genesis and TDK Lambda Genesis plus is supported.

- The behaviour of LimesControl with regard to power supplies has been changed. Formerly, LimesControl was acting like LIMES 2000, e.g. in case an active power supply was addressed within the power menu, the supply was switched off, even if a light source was still powered on.
  In the new version, the power status of the light source in LimesControl remains unchanged. This feature was introduced for cases when the user switches from manual to software control while the lamp is still on. Via LimesControl the user is now able to ramp down sensitive DUTs (like for instance a calibration lamp) in a controlled manner without the need for going back to manual.

Ambient Sensors

- Resistance values of NTCs have been added to Limes 2000 as a new ambient sensor reading. If such a sensor type is defined within *Options→Hardware→Ambient Sensor,* the button *Set NTC Data* is made available to store the specific NTC information.
  In order to enhance accuracy, a precision resistor is connected to the second channel of the NTC sensor module.
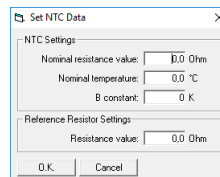
- In addition to thermocouple type K, it is now possible to choose other types, for instance type J.

- Henceforth, Limes 2000 will check if all sensor are connected. If a sensor is not available, the corresponding values will not be shown in the result table.
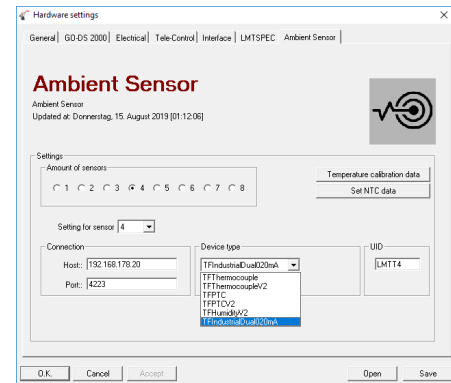
Miscellaneous

- Within the window *Control Goniometer*, it is now possible to switch between integration time of AMR devices. A box with radio buttons will appear to allow switching from slow to fast and vice versa.

- The minimum intensity level for transmitting all tristimulus values in grid or line scans with C3300 to LIMES 2000 has been reduced to 1000 digits, e.g. for white colour this corresponds to a minimum illuminance of approximately 0.5 lx.
  This means, if X + Y + Z ≥ 1000 digits, all three tristimulus values will be transferred to Limes and colour coordinates are calculated. If the sum of X, Y, Z is lower than 1000 digits, only the intensity, e.g. Y, is available.
  The minimum sensitivity for point measurements with C3300 is not affected and is even lower, because the software will average multiple readings.

- Unintentionally pressing the ESC key during a measurement terminated immediately all activities without the possibility to continue the measurement. This has been changed and henceforth the ESC key will have the same behaviour as the interrupt button, e.g. the user has the option to continue the measurement.

- During Eulumdat data export, the number of digits after the decimal point is now chosen from settings in *datatables*. This allows the user to explicitly decide the precision of exported intensity data.

- Reading angular encoders in LMT GO-H goniometers now differentiates between different types which have been used in the past, e.g. having display capabilities of 0°–360° (type 1), -180°–180° (type 2) and -280°–280° (type 3). Therefore, after moving the goniometer in manual mode and switching back to remote operation, the range for safely moving back to (0/0) could be increased for type 2 and is now -170°-170°.

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- S1000 PWM with re-aim will now also work with photometer II.

- In case the hardware test is started in LimesControl, the live mode (entry *Start* within the context menu of LimesControl) will be stopped and disabled until the hardware test window has been closed again.

- The Scantest routine in LimesControl was improved with regard to measurement of lx and cd setting behaviour.

- Databases having empty lines in the table *Programs* could not be loaded. The new revision will omit empty lines but will load the rest of the remaining program into Limes.

- A bug was fixed which occurred when a cone measurement with GO-DS was interrupted and then continued. Electrical and thermal values which were recorded before the interrupt were missing but will be restored with the new software revision.

- The stabilisation diagram (in LIMES 2000 usually called *Burn-in diagram*) is set in the LMT standard profile to automatic axis for *t* and *I* (or *E*).

- The correlated colour temperature T_c read from C1210 colorimeters is now replaced by the value based on the exact calculation method. Therefore, the range of T_c for C1210 systems is extended to red colour coordinates but the value shown in LIMES 2000 may slightly differ from the approximated number displayed by the C1210.