LumiCol 1900

Fast and precise 2-in-1 Imaging Colorimetry

Product highlights

- ▲ **Fast one-shot characterization of flat panel displays**
- ▲ **Built-in spot colorimeter including all features of CA-310**
- ▲ **User calibration guarantees highest accuracy**
- ▲ **Flexible lens focus**
- ▲ **Powerful and user-friendly software**

NEW

By combining their expertise and competencies in the field of display metrology, a novel imaging colorimeter for fast and precise luminance and color measurements of flat panel displays was developed by Konica Minolta and Instrument Systems.

The LumiCol 1900 is a high-speed 2-in-1 imaging colorimeter tailored to the needs and requirements of display testing in production lines. Using a very accurate, built-in spot colorimeter as reference for an RGB CMOS camera guarantees fast and precise 2D characterizations of whole displays with respect to luminance, chromaticity, contrast and uniformity etc. In addition, the integrated spot colorimeter allows for white balance, color gamut, gamma curve or even flicker measurements. Indeed a perfect match: the LumiCol 1900 combines the benefits of an RGB CMOS camera and a high accuracy spot colorimeter.

The LumiCol 1900 is controlled by the comprehensive new Instrument Systems software LumiSuite which comes with a software development kit optimized for automated usage in production lines and a user-friendly graphical user interface for laboratory applications.

Instrument Systems

KONICA MINOLTA Group

Fast and accurate characterization of displays

The innovative 2-in-1 display measurement device uses the very accurate tristimulus measurement of Konica Minolta's CA-310 spot colorimeter as a reference for the 2D RGB images of the CMOS camera. The integrated beam splitter allows for simultaneous measurement of the camera and the spot colorimeter. Figure 1 illustrates the design concept of the LumiCol 1900.
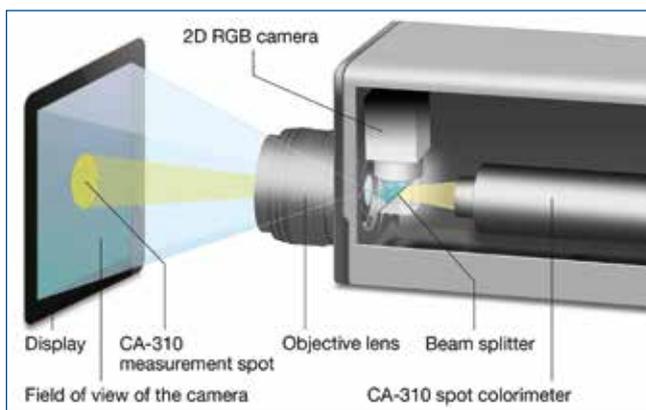

Figure 1: Design concept of the LumiCol 1900.

Here, the colorimeter is adjusted to measure in the center of the camera's field of view (Figure 2). The diameter of the colorimeter spot measurement is about 28% of the vertical field of view of the camera.

Figure 2: The yellow circle represents the CA-310 measurement spot, the blue area indicates the camera's field of view.

The colorimeter is used as reference during the calibration process as well as live-reference for every camera measurement. During calibration, a transformation matrix is determined by comparing the measurement results of the colorimeter and the integrated values of the camera in the area of the spot colorimeter measurement. As calibration source, a standard monitor displaying a large set of different colors is used. The calibration matrix transforms the RGB values of the CMOS camera into XYZ. A further increase of the accuracy is achieved by an additional correction value applied after the transformation. This value is determined from the live comparison of colorimeter and camera results and is renewed with every measurement performed.

As a result, the high accuracy of the CA-310 XYZ measurement is transferred to the 2D image of the CMOS camera. The specifications for luminance and color measurements with the LumiCol 1900 can keep up with state-of-the-art filter-wheel based imaging colorimeters. A striking advantage over such colorimeters is the extremely high measurement speed, which is achieved by capturing all color and luminance information with a single exposure.

Two devices in one

Combining two devices, the LumiCol 1900 offers all typical functions of a CMOS camera and a spot colorimeter:

◢ Measurement of color and luminance
◢ Determination of color and luminance uniformity
◢ Contrast measurement
◢ Measurement of white balance, gamma, color-gamut etc.
◢ Flicker measurements (only model "Flicker")

The LumiCol 1900 is available in two variants, the type Flicker (F), which is optimized for liquid crystal displays and allows for JEITA and contrast flicker measurements, and the type Universal (U) for the investigation of all types of displays.

New software   LumiSuite

The LumiCol 1900 comes with a new software platform which is optimized for the typical processes of automated production or quality control, as well as for R&D applications. The comprehensive LumiSuite software supports various applications with specific functions that allow for a wide range of measuring tasks to be carried out fast.
The software development kit (SDK) guarantees easy and flexible integration in typical display production lines. For laboratory applications, the workflow from data acquisition via image processing to image analysis is organized in a user-friendly and modular graphical user interface (GUI). Two modules are available: SmartAnalysis module and BlackMura module.
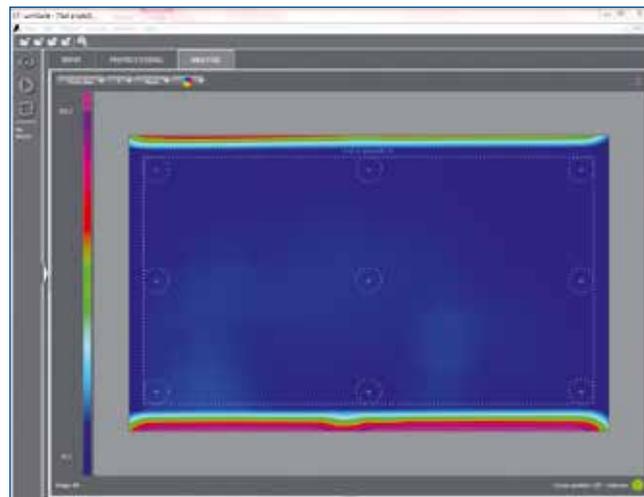
Screenshot of the LumiSuite GUI (SmartAnalysis), showing an image of a display in pseudo-color representation.
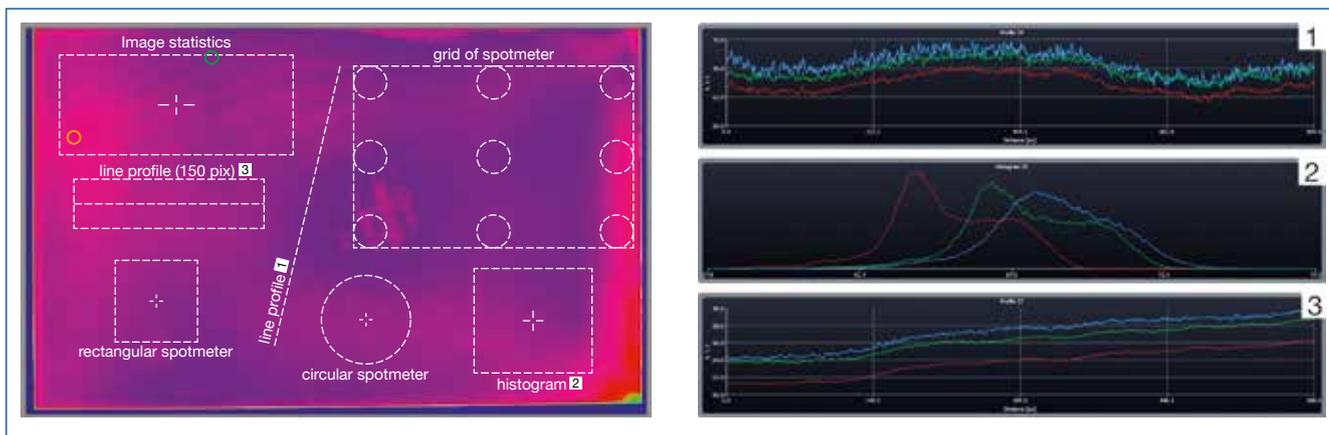
Image analysis with the SmartAnalysis module. Left: Luminance of a display in pseudo-color representation with various analysis tools applied in the XYZ color space. Rectangle for image statistics in a certain region including the darkest and the brightest spot (green and red circle), line profile for analysis of the XYZ values along a line placed on the image (1), histogram tool to determine the color distribution in a specific region (2), line profile averaging over 150 pixels (3), rectangular- and circular spotmeter and grid of spotmeter to derive minimum, maximum, average values etc. Right: Graphical representation of (1), (2) and (3) (top down; red, green and blue lines represent the color coordinates X, Y and Z, respectively).

SmartAnalysis module

The comprehensive SmartAnalysis module offers a complete set of analysis tools for the general analysis and characterization of 2D images:

- ◢ Spotmeter
- ◢ Grid of spotmeter
- ◢ Line profiles
- ◢ Histogram
- ◢ Luminance and color uniformity
- ◢ Focusing aid (slanted edge method)
- ◢ Image statistics

BlackMura module

The BlackMura module is designed for Black Mura analyses in accordance with the latest version of the official standard UMSfD (Uniformity Measurement Standard for Displays) used by the German automotive industry. With its user-friendly and transparent workflow, the module delivers easy and traceable Black Mura and uniformity analyses. Moreover, advanced users can modify the parameters for analyses beyond the standard.
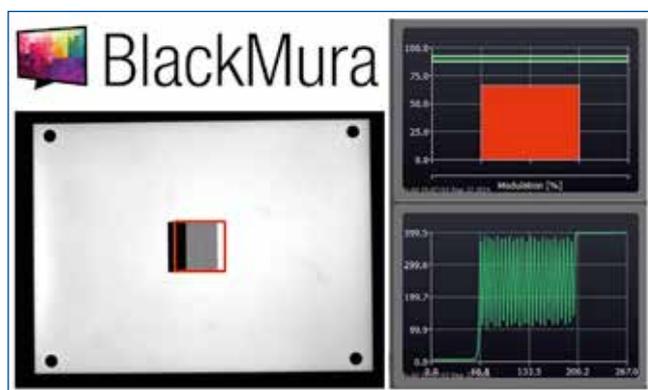
Black Mura Analysis. Left: Test pattern used for adjustment of the focus of the imaging light measurement device. Top right: The actual modulation value (red bar), target modulation (green range). Bottom right: Luminance values (green line) according to the rectangular profile on the image (marked red).

Perfect for automated display testing in production lines

The LumiCol 1900 was designed to serve in particular the requirements of display testing in production lines.

Fast and accurate
Thanks to its 2-in-1 design, the LumiCol 1900 allows for performing fast and accurate optical characterizations of whole displays.

Cost effectiveness
The LumiCol 1900 offers substantial time and cost savings, because it acquires 2D images very fast and combines the functionality of two measurement devices into a single device, i.e. reduces the number of test stations required in the production lines equipped with it.

Easy integration
The SDK of the new LumiSuite software is optimized for easy and flexible integration into production lines.

Comprehensive analysis in the lab

The user-friendly GUI offers all that is needed for a comprehensive analysis in the laboratory. The operator can use the flexible tools to perform a variety of different evaluations. The data processing is always transparent, the necessary parameters are well organized and easily accessible. Therefore, the LumiSuite enables the operator to perform his tasks very efficiently.

Order Information

Order number	Description
LCO1900-100-FB	2-in-1 imaging colorimeter with 1900 x 1180 pixels (built-in CA-310 spot colorimeter; incl. 28 mm lens, calibration, SDK and LumiSuite; Gigabit Ethernet interface); type: Flicker; color: black
LCO1900-100-FG	As above; type: Flicker; color: gray
LCO1900-100-UB	As above; type: Universal; color: black
LCO1900-100-UG	As above; type: Universal; color: gray

Technical data

LumiCol 1900	
Models	**Description**
Universal (U)	All display types, no flicker measurement
Flicker (F)	For liquid crystal displays, including flicker measurement (Contrast and JEITA method)
Measurement quantities	
2D	Luminance, color
Spot	Luminance, color, flicker (only model F)
Camera specifications	
Effective resolution (h x v)	~1900 x 1180 pixels (2.2 megapixels)
Pixel size	5.86 µm x 5.86 µm
AD converter	12 bit
Size CMOS sensor	1/1.2", 13.3 mm diagonal
General specifications	
Interface	Gigabit Ethernet
Operating system	Windows 7
Dimensions (l x w x h, incl. lens)	222 mm x 100 mm x 131 mm
Weight	2.5 kg
Power supply	12 V
Operating temperature range	10 °C - 35 °C

Measurement performance			
Measurement range[1]	L_v = 0.01 cd/m² - 5000 cd/m²		
Luminance accuracies[2]	**100 cd/m²**	**1 cd/m²**	**0.3 cd/m²**
Accuracy to reference instrument[3]	1.2 %	2.0 % / 1.5 %[4]	3.5 % / 2.0 %[4]
Instrumental precision CA-310[5]	0.1 %	0.35 % / 0.3 %[4]	1.5 % / 1.0 %[4]
Instrumental precision camera[6]	0.5 %	0.7 %	2.5 %
Polarization sensitivity[7]	1.0 %	-	-
Color accuracies[2]	**100 cd/m²**	**1 cd/m²**	**0.3 cd/m²**
Accuracy to reference instrument[3]	0.0015	0.0025 / 0.0015[4]	0.0040 / 0.0030[4]
Instrumental precision CA-310[5]	0.0002	0.002 / 0.0015[4]	0.005 / 0.0030[4]
Instrumental precision camera[6]	0.0015	0.003	0.004
Polarization sensitivity[7]	0.0025	-	-
Measurement time	**100 cd/m²**	**1 cd/m²**	**0.3 cd/m²**
Measurement time hybrid mode[8]	0.5 s	1.5 s	3.5 s
Measurement time CA-310 only	65 ms	330 ms	1 s

Flicker (only model LumiCol 1900 F)	
Measurement range	> 15 cd/m²
Display range (Contrast method)	0...999 %
Accuracy (Contrast method)	±1 % / ±2 % (30 Hz/60 Hz; 10 % sine wave)
Instrument precision (Contrast method, 2σ)	1 % (30 Hz; 10 % sine wave)
Accuracy (JEITA method)	±0.5 dB (30 Hz, 10 % sine wave)
Instrument precision (JEITA method, 2σ)	0.3 dB (30 Hz; 10 % sine wave)
Lens 28 mm	
Minimum working distance (at focus)	220 mm
Aperture	f/2.8

Spot size and field of view at selected working distances							
Working distance[9] [mm]	**220**	**550**	**1000**	**1500**	**2000**	**2500**	**3000**
Spot size [mm]	12	34	64	97	131	164	198
Field of view [mm]	70 x 44	200 x 126	379 x 237	577 x 361	775 x 484	973 x 608	1171 x 732
Field of view diagonal [in]	3.3	9.3	17.6	26.8	36.0	45.2	54.4

[1] L_v = 0.01 cd/m² valid for the 2D chroma mode (camera only; SNR 10:1);
for hybrid mode: 0.1 cd/m² - 5000 cd/m².
[2] All measurement accuracies apply to a threefold standard deviation (3σ).
[3] Compared to a high-precision spectroradiometer as reference instrument measured
on a reference display using hybrid mode. Uncertainty of reference instrument not
considered.
[4] Measured with low luminance mode.

[5] Repeated measurements of unchanged setup.
[6] Max. standard deviation of 25 images (8 x 8 binning) obtained from unchanged setup.
Auto exposure used for 100 cd/m²; fixed exposure of 1 s / 3 s for 1 cd/m² / 0.3 cd/m².
[7] Max. deviation from mean with linear polarized light.
[8] Depends on PC processing capability. Auto exposure for 100 cd/m²;
fixed exposure of 1 s / 3 s for 1 cd/m² / 0.3 cd/m².
[9] Distance between DUT and front plate of LumiCol 1900.