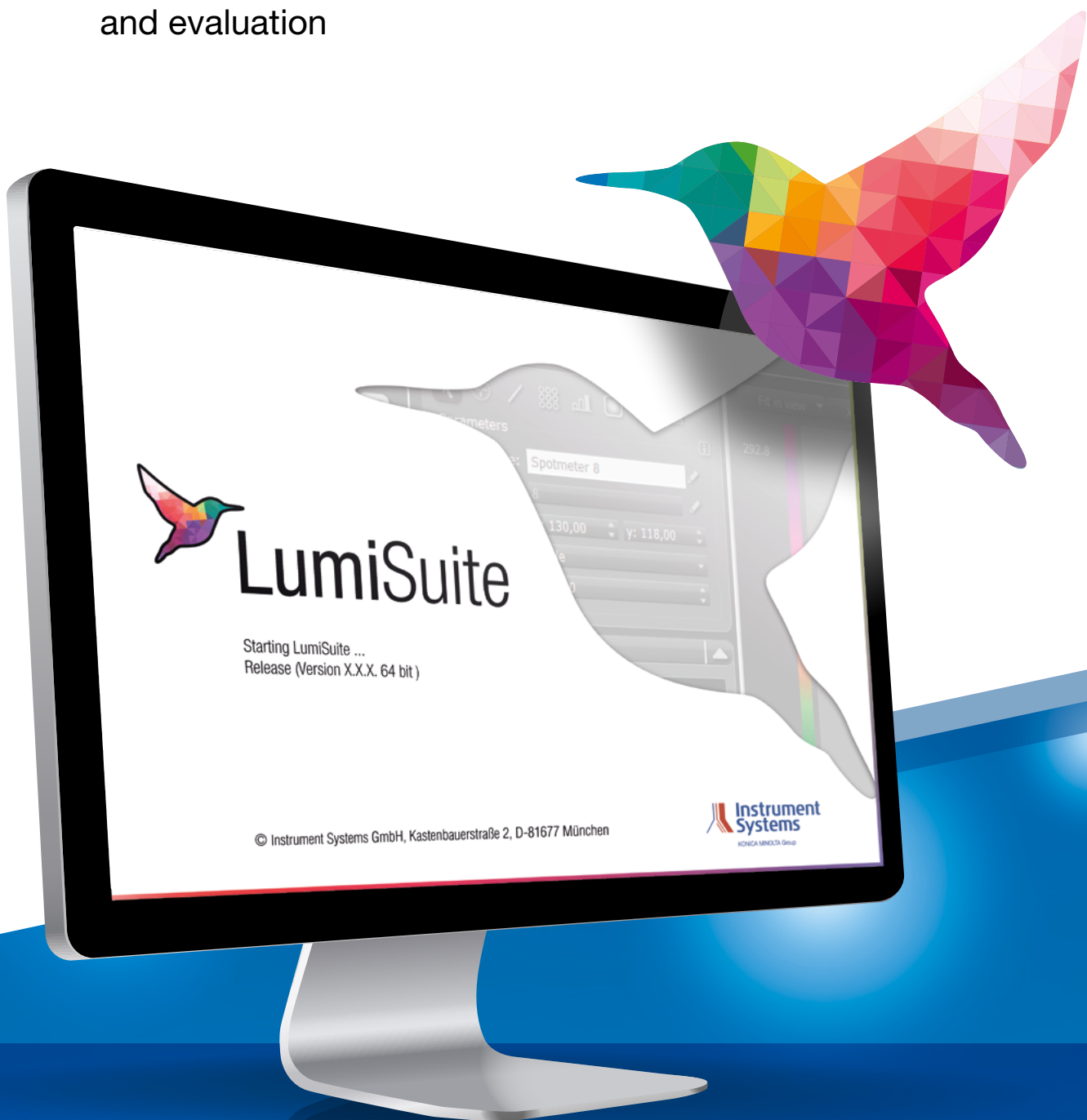


# LumiSuite

Powerful software for 2D image acquisition  
and evaluation



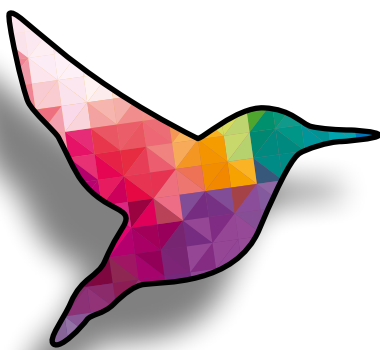
We bring quality to light.



#### LumiSuite highlights

- ▲ User-friendly, efficient graphical user interface and industry-proven software development kit
- ▲ Fast and precise data acquisition
- ▲ Compatible with Instrument Systems' large hardware portfolio of high-quality photometers, colorimeters and VCSEL testing cameras
- ▲ Elaborate catalogue of image processing tools
- ▲ Powerful and steadily growing 2D image analysis features
- ▲ BlackMura plug-in
- ▲ MultiPoint Correction plug-in for view-direction dependent correction of luminance and color

## 01 \\ LumiSuite – Powerful solution for 2D image capturing and evaluation



LumiSuite is a paramount software platform to capture and evaluate spatially resolved radio- and photometric DUT information with Instrument Systems' photometers, colorimeters and infrared cameras. We continuously develop our LumiSuite software to evaluate measured data according to international standards in the display and automotive industry.

The unique combination of our modern imaging technology and advanced image analysis has propelled our LumiSuite to an industry-proven software. It finds application in 100% EOL display testing, quality assurance in the automotive sector, in VCSEL testing and  $\mu$ -LED wafer testing.



Fig.1: LumiSuite solutions perform in display characterization, the automotive interior, in VCSEL or ( $\mu$ )LED testing.

## 02 \\ LumiSuite – User-friendly Smart Analysis concept and industry-proven software development kit

LumiSuite's user-friendly graphical user interface (GUI) guides an operator intuitively through the individual steps of a workflow for data evaluation. The workflow of the LumiSuite Smart Analysis is organized in an easy 3-step logical sequence:

A user-specific workflow including the applied image processing steps and image analyses can be saved and reloaded as a GUI recipe to minimize measurement effort and time. In addition to the comprehensible GUI, our LumiSuite software

is equipped with an extensive and industry-proven software development kit (SDK) in C and .NET. This allows a straight-forward implementation of our LumiSuite solutions into automated systems in laboratory and production environment.



## 03 \\ LumiSuite Smart Analysis – Fast and precise data acquisition



The LumiSuite software is the core of our modern imaging technology and compatible with Instrument Systems' large hardware portfolio of high-quality imaging devices. Upon your required measurement solution LumiSuite will be your strong partner for the corresponding data acquisition and analysis. The software allows opening multiple projects as well as multiple connected devices at the same time.



Fig. 2: The LumiCam B series, the LumiTop variants and the VTC systems are all compatible with the LumiSuite.

The LumiSuite Smart Analysis software supports the following camera technologies<sup>1</sup>:



- ▲ **VTC 4000** advanced testing system for near-field analysis of VCSEL arrays. This high performance measuring solution allows a single-shot detection of the position and the radiated power of individual emitters on a VCSEL array.
- ▲ **LumiTop 2700/4000** spectrally-enhanced 2D imaging photometer and colorimeter and

the **LumiTop X** series like the **X150** ultra-high resolution, our all-in-one solution for quality control at pixel level. From displays for smart watches to TVs, back light units or  $\mu$ LED wafers, the measurement solutions featuring our LumiTop cameras deliver fast and precise data for quality control in laboratory and production.

- ▲ **LumiCam B** (Mono, Color and Advanced) 2D imaging colorimeter with motorized objective lenses. A precise determination of luminance and color distribution data is only a matter of seconds.

## 04 \\ LumiSuite Smart Analysis – Image processing and analysis

### Image processing

LumiSuite Smart Analysis comes with an elaborate catalogue of image processing tools such as:

- ▲ Auto display recognition / auto-cropping
- ▲ Perspective correction
- ▲ Moiré removal
- ▲ Binning
- ▲ Median and Gaussian filter
- ▲ Cropping and refilling

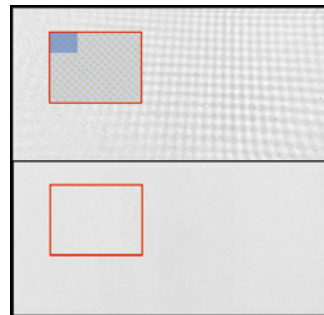


Fig 3: Moiré removal tool (upper panel: Moiré artifacts; lower panel: Moiré removal applied; red square is a zoom in of the blue shaded area).

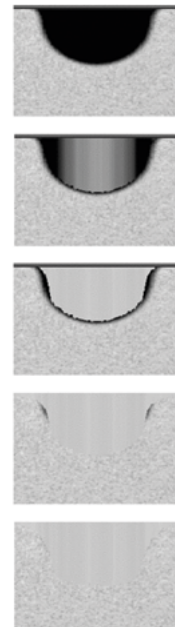


Fig. 4: Fill up a notch with our advanced parameter settings for image cropping and filling.

<sup>1</sup> For further information on our hardware solutions please have a look at our website at <https://www.instrumentsystems.com> or contact our sales engineers directly. We gladly assist.

## Image analysis

With its diverse image analysis functions, LumiSuite Smart Analysis is ideally suited for the comprehensive characterization of modules, displays, and cluster instruments. Software features are powerful and steadily growing:

- ▲ Comprehensive 2D color image analysis, such as spotmeter in elliptic or rectangular form and flexible line profiles defined by individual anchor points
- ▲ Testing of color, gamma and dot defects according to the standards of the German OEMs
- ▲ Determination of flicker and luminance modulations
- ▲ Defects detection tool, evaluating an image for dot-shaped, line shaped or blob-shaped (general defect of any shape) artifacts
- ▲ Single pixel algorithm for pixel array analysis (e.g. display pixel calibration, wafer testing, VCSEL array evaluation)
- ▲ Mura audit and Black Mura audit<sup>2</sup> according to OEM standards
- ▲ MultiPoint Correction tool<sup>2</sup> for generating 2D DUT-specific spectral correction images

In the LumiSuite Smart Analysis, spotmeter can be placed in rectangular or elliptic form or in a grid of spotmeter. Results are offered in the CIE color chart. Supported color spaces for image analysis are XYZ, L<sub>v</sub> xy, L<sub>v</sub> u'v', L<sub>v</sub> uv.

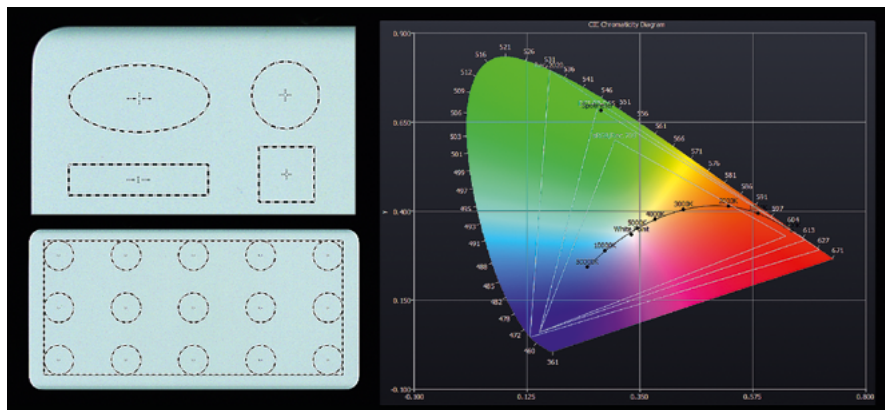


Fig. 5: Spotmeter analysis.

Stay in shape with the polyline feature - one of our comprehensive 2D color image analysis tools to extract luminance values along bended samples.

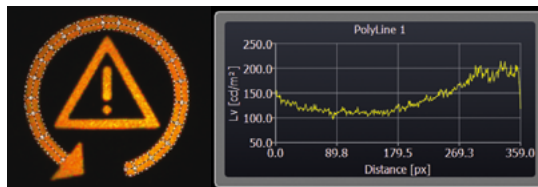


Fig. 6: Polyline analysis.

The defects detection tool probes an image for the presence of dot-shaped, line-shaped, or blob-shaped (general defect of any shape) artifacts. The tool provides information on the x- and y-position of the defect, as well as the size and the luminance of the artifact. The upper image of Fig. 7 shows an example for a threshold image, the lower picture is the corresponding results image.

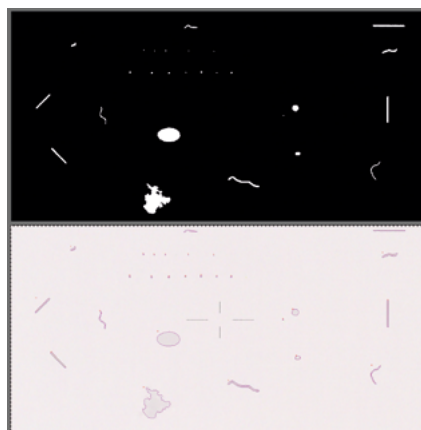


Fig. 7: Defects detection tool.

<sup>2</sup> Extra LumiSuite Plug-In. Requires additional license key to be accessible. See ordering information below for details. Please do not hesitate to ask our sales engineers in case you have questions.



The single pixel analysis detects emitters (typically  $\mu$ LEDs) within an image and evaluates their intensities. The tool determines cell coordinates, tri-stimulus values, dominant wavelength, purity, blob centroid and blob width/height. Left upper image of Fig. 8 shows boundary boxes around each emitter in the detection image. In the left lower image each emitter appears in a different color than its neighbor. The right image visualizes that the single pixel analysis can also handle completely missing lines.

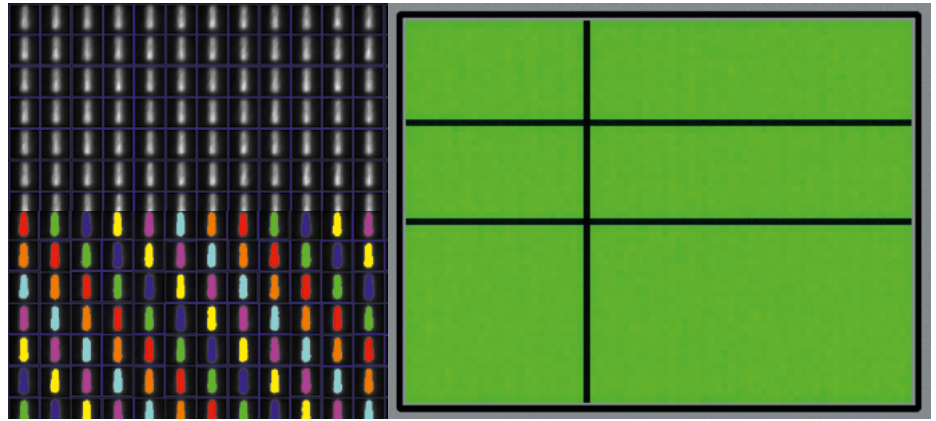
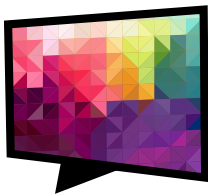


Fig. 8: Single pixel analysis.

## 05 \\ LumiSuite – Black Mura and MultiPoint Correction plug-ins



BlackMura

The Black Mura plug-in for LumiSuite analyses the 2D luminance homogeneity in accordance to the official standard (Uniformity Measurement Standard for Displays) of the German Automotive Industry.

The MultiPoint Correction plug-in for LumiSuite generates a spectral reference image to correct an image for a DUT-specific view direction dependence of luminance and color.



MultiPoint Correction

## 06 \\ LumiSuite – Licensing

LumiSuite Smart Analysis is licensed using the general Instrument Systems software license. Additional plug-ins such as Black Mura or MultiPoint Correction need an extra license key to be accessible to the

operator. A non-accessible plug-in will stay in shaded demo mode. That means it is possible to demonstrate a plug-in's capabilities, but (among other limitations) no data can be exported.

## 07 \\ Ordering information

Order number	Description
<b>LumiSuite Smart Analysis</b>	
SW-530	LumiSuite Smart Analysis SDK. Contains SDK (software development kit) for comprehensive analysis of luminance and color images
SW-540	LumiSuite Smart Analysis GUI. Contains GUI (graphical user interface) for comprehensive analysis of luminance and color images
SW-550	LumiSuite Smart Analysis Software. Contains GUI (graphical user interface) and SDK (software development kit) for comprehensive analysis of luminance and color images
SW-560	LumiSuite Smart Analysis Software for macOS. Contains GUI (graphical user interface) and SDK (software development kit) for comprehensive analysis of luminance and color images
<b>Plug-Ins</b>	
SW-550-BM	Black Mura Plug-In for LumiSuite SW (GUI and SDK); Analysis of displays according to the standard „Uniformity measurement standard for Displays“ of the German car industry
SW-550-MPC	Multipoint Correction Plug-In for LumiSuite SW (GUI and SDK) for the compensation of i.e. DUT-specific viewing angle effects

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