iQ-Luminance

User Manual

11 July 2022

CONTENT

1 INTRODUCTION

The iQ-Luminance software calculates luminance values from the image data taken with a calibrated camera. The obligatory camera calibration provides how the camera's raw RGB data are mapped to the Luminance considering various exposure settings. Rectangular, elliptical, circular, or polygonal Regions of Interest (ROI) can be drawn on the image to evaluate the selected area. The corresponding Luminance is displayed as a grayscale or false-color image.

2 PRECONDITIONS

2.1 Camera Calibration

The obligatory camera calibration provides the knowledge of how the camera's raw RGB data are mapped to the Luminance considering various exposure settings. This camera- and lens-specific calibration is performed in our test lab.

Attention! You must send Image Engineering your camera for calibration <u>before</u> you use the software. Without a pre-calibration from IE, you will not be able to use the software.

The camera calibration requires two measurements:

- Opto-electronic conversion function (OECF)
- Spectral response (SR)
- **Optional:** Shading correction

2.2 System Requirements

Operating system → Windows 7 **64bit** (or newer)

3 GETTING STARTED WITH THE USER INTERFACE

You will need to input the license key when starting the software for the first time. The key can be found on the USB stick that will be sent to you upon purchase of the software. Without the license key, you can only access the demo version. Only the example images provided by IE are compatible with the demo version (images are available for download on our website).

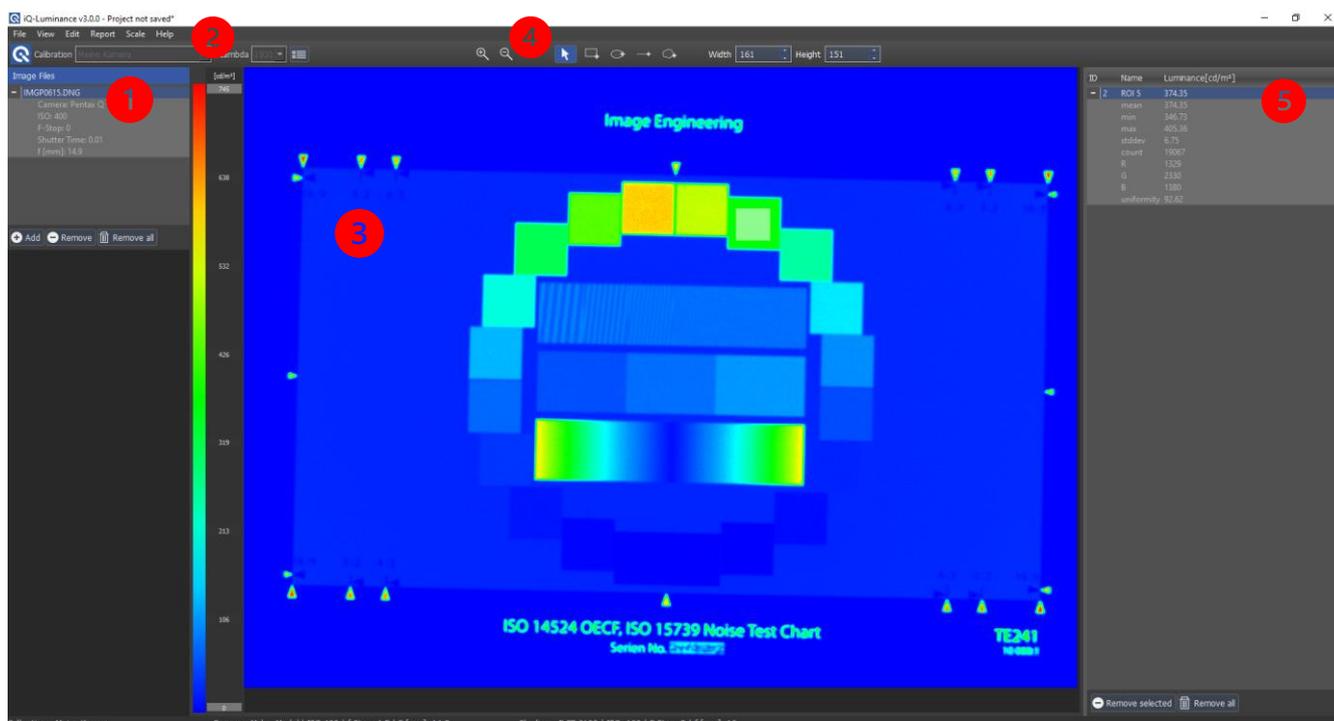The iQ-Luminance software is divided into three operation areas:

Image 1: The iQ-Luminance user interface.

1. **Control area**
   - Manage images for measurement in a file list

2. **Menu Bar**
   - File   → Open/close image files
   - View   → Switch between three different image views/export and import ROIs
   - Edit   → ROI management
   - Report→ Edit report or Export report
   - Scale → Switch between logarithmic or linear scale/reset scale

View and **Report** are visible if an image is loaded.

Scale is visible when an image is loaded, and a luminance view is active.

3. Image
- Displays the current image
- Displays a color-coded luminance image with a color bar
- ROIs can be drawn directly on the image

4. Image Toolbox
- Contains measurement (Rectangle ROI, Ellipse ROI, Line, Polygon ROI) and display tools (zoom in / out)

5. Results Area
- Displays and manages measurements of selected areas

Image area and **Results area** are visible if an image is loaded.

3.1 Control Area

3.1.1 Manage Images

The iQ-Luminance software only supports the usage of RAW image files, and the calibration data provided by IE are based on RAW images.

⊕　　Add image files to a list

⊖ Remove selected image files from the list

🗑 Clear list

[+/−]　　Show or hide additional meta-information of the image

3.1.2 Load Calibration Data

The camera and lens-specific calibration is performed in our test lab.

The software is delivered with calibration text files that can then be loaded in the calibration data screen:
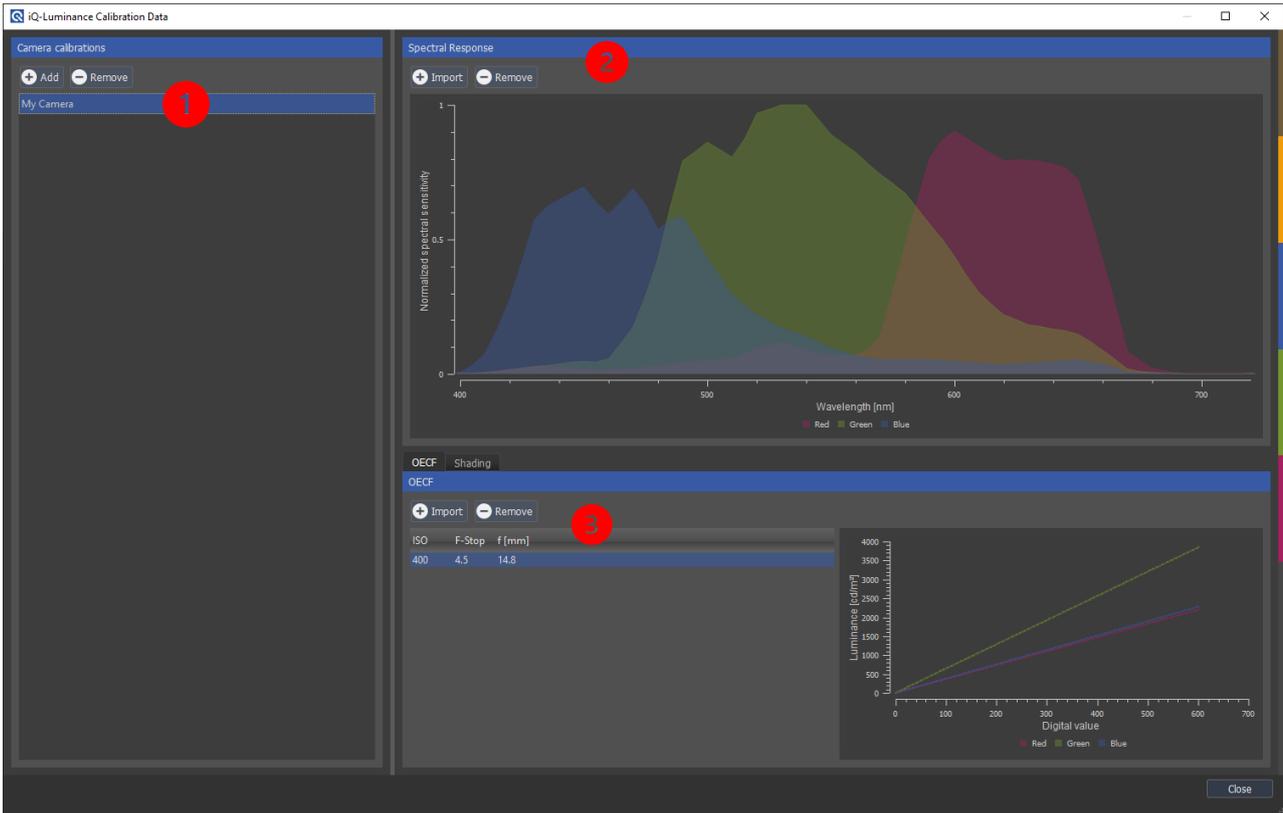
File → Calibration Data
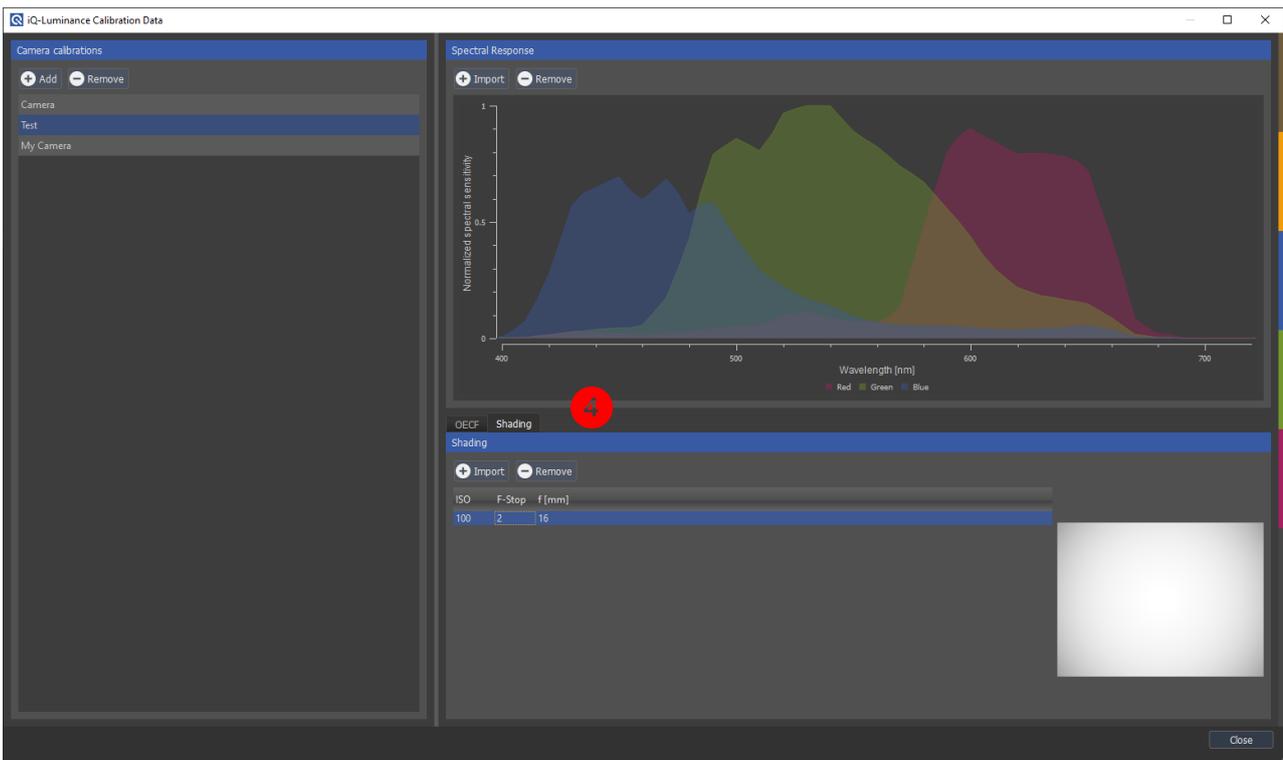

Image 2: iQ-Luminance calibration data

Image 3: Optional shading measurements

1. Add (+) or remove (-) a set of calibration data (e.g., for one camera lens combination). You can rename the set of files once loaded (double click the file name)
   Select a set of calibration data by clicking on the specific entry.
   The currently active set displayed on the right side and used by the software is highlighted with a blue background color.
2. Spectral response (SR)
   Import or remove (-) the spectral response calibration file
3. Opto-electronic conversion function (OECF)
   Load or remove one or more OECF calibration files
4. Shading data (**optional**) – image 3
   Load one or more shading correction calibration files

If you select more than one OECF or shading calibration file, the software will choose the suited calibration files based on the exposure of the loaded image (ISO, f-stop, f [mm]). The software will ensure that the ISO and f-stop for both the calibration and image files match.

Your calibration data will be saved and available after loading the calibration files.

Once saved, the calibration data is also accessible from the calibration menu on the left side (image 4).
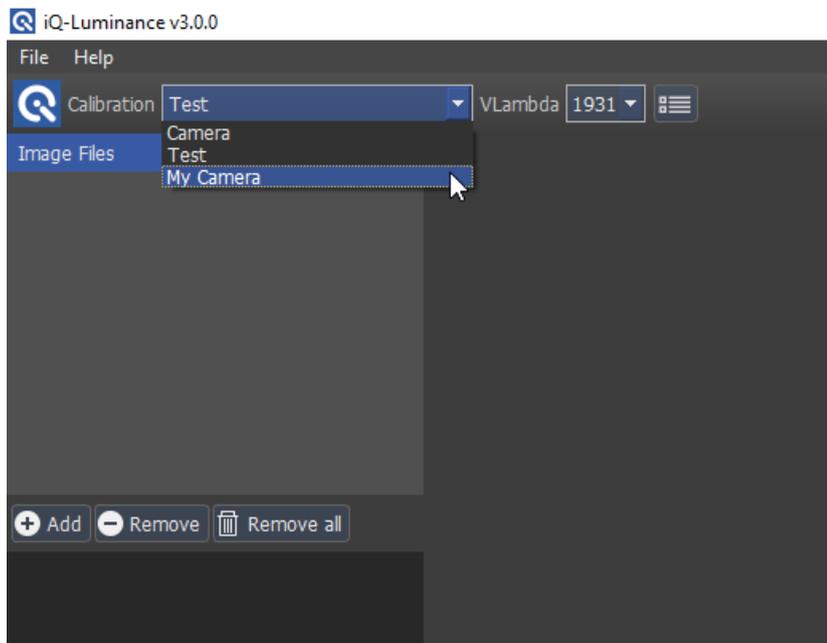

Image 4: Accessing calibration data

3.1.3 Selecting Vλ

For more information on vλ 2006, please follow the link below:

Official publication:

https://cie.co.at/publications/fundamental-chromaticity-diagram-physiological-axes-part-1 Additional text files for the v(symbol) curve 2006 (files already implanted into the iQ-Luminance software):
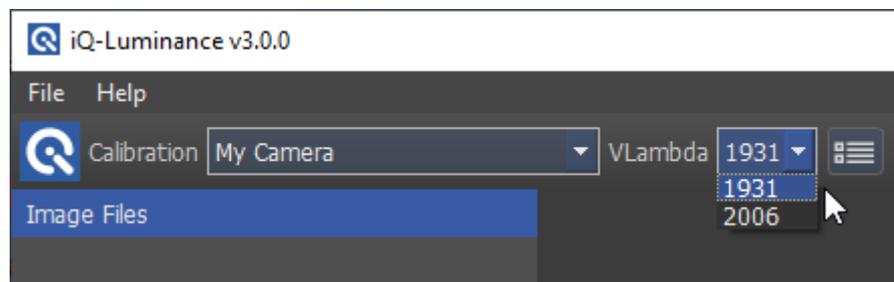
http://cvrl.ioo.ucl.ac.uk/ciepr.htm

Image 5: Set VLambda curve

3.2   Image Management

After loading and selecting an image, it is displayed in the **image area**.

The **toolbox** will then appear above the image and the **result area** to the right beside the image.

The toolbox contains tools to select ROIs for the measurement and some options for displaying the image.

3.2.1   Zoom In and Out

Zoom in: You can zoom to a specific area by clicking and dragging a rectangle over the desired location.

Zoom out: Displays the entire image.

3.2.2   Select an ROI

iQ-Luminance offers four different shapes when selecting a region of interest:

Rectangular ROI

Elliptical ROI

Arbitrary line

After choosing one of the above tools, the ROI is created by clicking and dragging the desired shape over the image.

Polygonal ROI

The polygon is created by clicking into the image. Each click sets a point of the polygon.

You can select a minimum of three points.

ok After setting the points, you must confirm the shape. You can create multiple shapes on the image.

x Click to cancel a shape that has not been confirmed or to go back to the main menu bar.

Multiple ROIs may be created, which are managed in the result area. The ROIs can be moved and re-shaped afterward. To remove a shape that has been confirmed, right-click the shape and delete ROI.

Please note: While you are in Polygon mode, most of the GUI will be disabled until you confirm or cancel the polygon creation.

3.3 ROI Management

Control and move multiple ROIs at one time by holding down the Ctrl key and selecting the ROIs you would like to control.

You can delete an ROI by right-clicking and selecting delete.

Selected ROIs can be resized by typing new values into fields Width and Height.

Selected ROIs can be copied and pasted into the same or into other images (image 4).
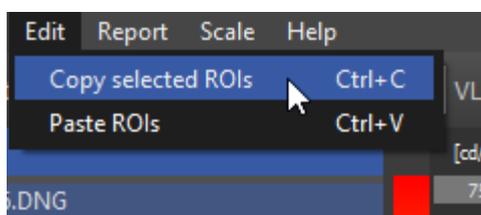

Image 6

You can save, export, and import ROIs in the **View** dropdown menu.

3.4 Save and Load Projects

You can save your project and load it again at any time. The image and the ROIs will be saved as well.

File → Save Project

3.5 Change the Display Mode

The iQ-Luminance software offers three different display modes found in the menu bar:

View → Original RGB

View → Luminance (B/W)

View → Luminance (Color)

Luminance (Black/White) and **Luminance (color)** means that the measured luminance values in the image are displayed using grayscale (image 5) or false colors (image 6) with corresponding luminance values in candela per square meter.

A color bar on the left side of the image indicates the correlation between color or gray values in the image and luminance values.
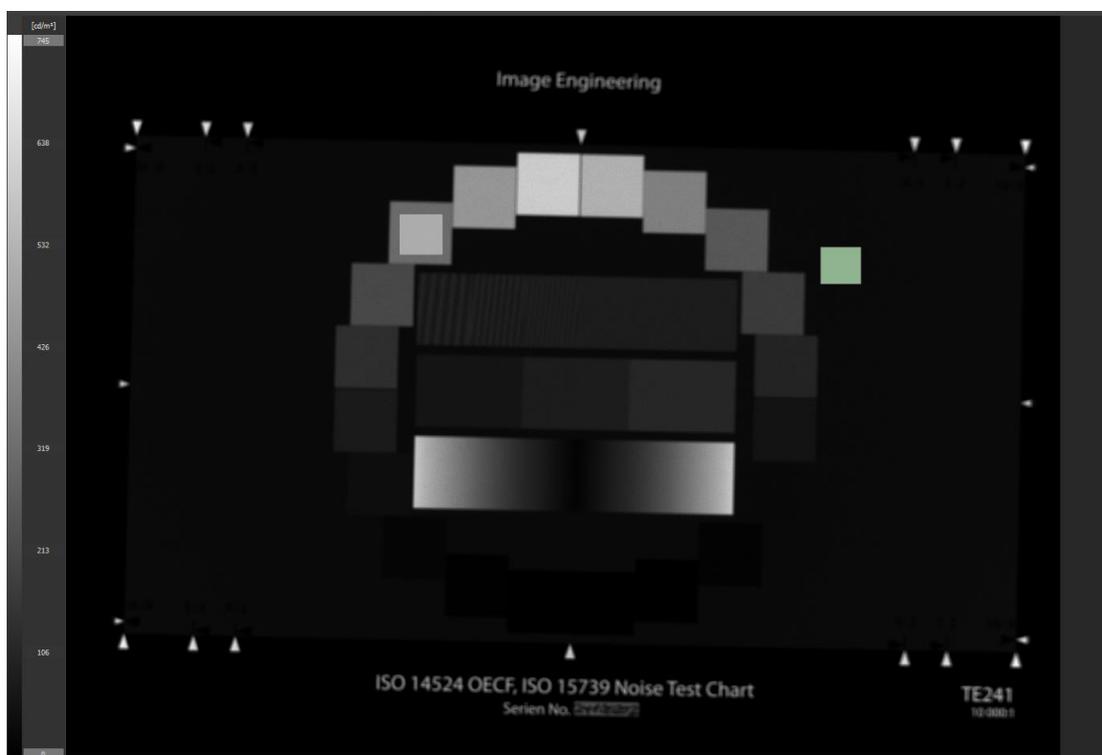

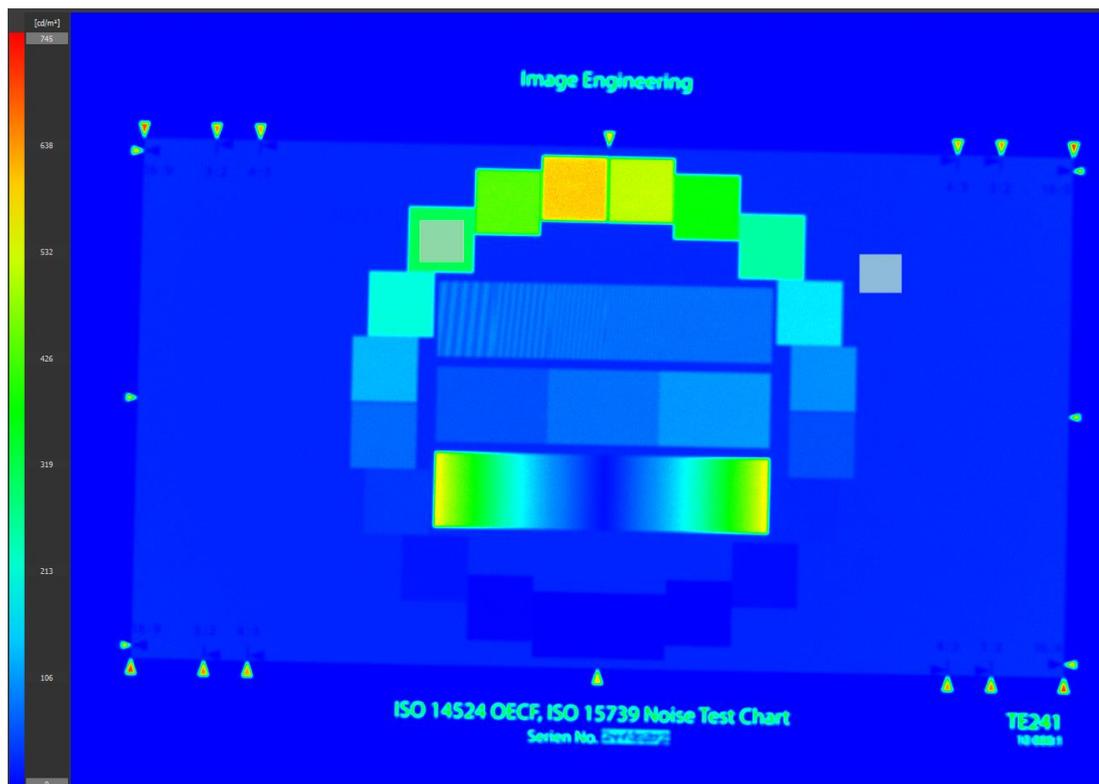**Image 7: Luminance greyscale display**

Image 8: Luminance false color display

3.5.1 Scaling the Luminance Value Range

It is possible to change the correlation between color and luminance values.

The denotation of false colors / grayscale values:

Red (false color) / white (grayscale) means a high luminance value.

Blue (false color) / black (grayscale) means a low luminance value.

When loading an image, the maximum and minimum luminance values are calculated and used as limits for this scaling.

The scaling can be changed by entering new values in the fields for the minimum and maximum values.
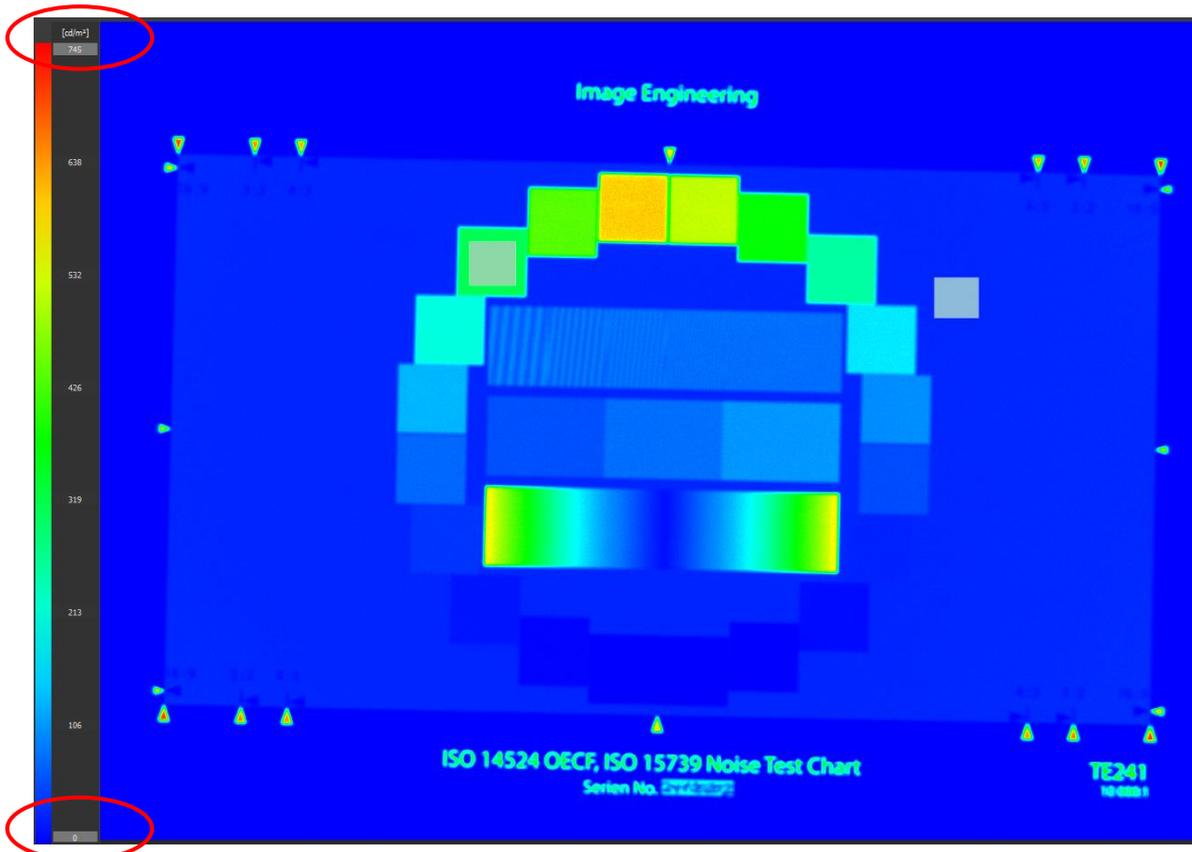
Image 9: Edit the minimum and maximum luminance value

You can apply the scaling of the current image to all opened images in the menu bar:

Scale → Apply Range to all Open Images

Scale → Reset Range resets the limits of the current image to maximum and minimum luminance values of the image.

3.6   Logarithmic Scaling

You can switch to logarithmic scaling in the menu bar:

Scale → Logarithmic Scale

3.7   Result Area

Every ROI created in the image appears in the results list along with the measured luminance value.

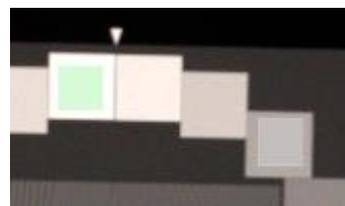**Image 10: An example of ROIs with luminance values**

The currently selected ROI is highlighted in both the image and the result list.

Toggling the selection in the list activates the corresponding ROI in the image.

3.8 Profile Plot

The line selection is used to evaluate a luminance distribution along a line with variable width. The luminance values along this line are be plotted in a chart:
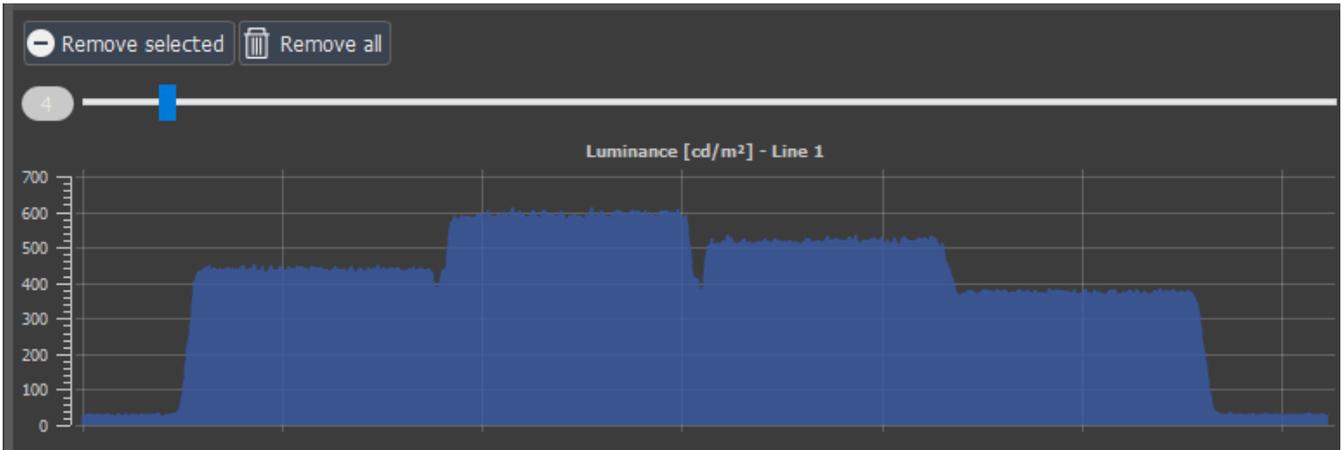
Image 11: The slider above the plot changes the width of the line

4   RESULT EXPORT

You can export the results as an XML file.

You can add your logo, title, editor, and date to the PDF Export.

You can open the relevant dialog in the menu bar:

Report → Configure

4.1   Report Generation (PDF)

Fill out the correct information.

The "Show ROI" checkboxes imply that you can show the ROIs either on the false-color image or the report image.
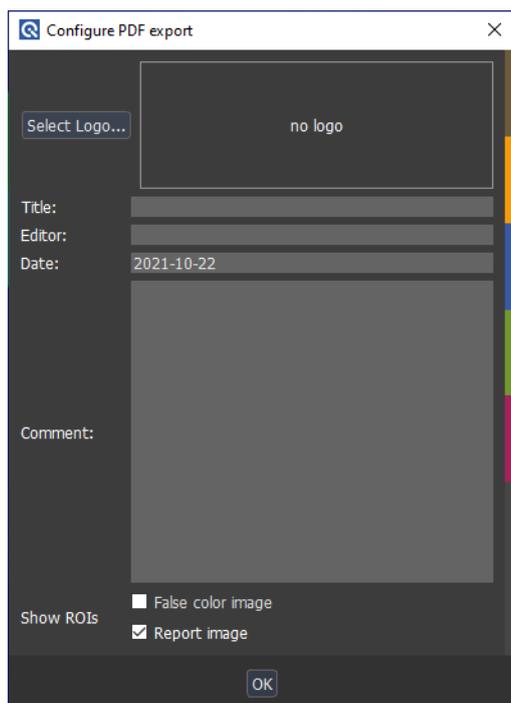
Image 12: PDF configuration

5 TRADEMARK AND COPYRIGHT

5.1 Trademarks

Microsoft® and Windows® are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

5.2 Software by Third Parties

Armadillo
Armadillo C++ Linear Algebra Library is licensed under the Apache License 2.0
Copyright 2008-2020 Conrad Sanderson
Copyright 2008-2016 National ICT Australia (NICTA)
Copyright 2017-2020 Arroyo Consortium
Copyright 2017-2020 Data61, CSIRO
This product includes software developed by Conrad Sanderson
This product includes software developed at National ICT Australia (NICTA)
This product includes software developed at Arroyo Consortium
This product includes software developed at Data61, CSIRO

dcraw
Copyright © 1997-2015 by Dave Coffin
This is free software. Web site of the author: http://www.dechifro.org/index.html
The documentation can be found here: http://www.dechifro.org/dcraw/dcraw.1.html
(www.cybercom.net/~dcoffin/dcraw/)

OpenCV - Open Source Computer Vision Library
License Agreement For Open Source Computer Vision Library (3-clause BSD License)

Copyright (C) 2000-2020, Intel Corporation, all rights reserved.
Copyright (C) 2009-2011, Willow Garage Inc., all rights reserved.
Copyright (C) 2009-2016, NVIDIA Corporation, all rights reserved.
Copyright (C) 2010-2013, Advanced Micro Devices, Inc., all rights reserved.
Copyright (C) 2015-2016, OpenCV Foundation, all rights reserved.
Copyright (C) 2015-2016, Itseez Inc., all rights reserved.
Copyright (C) 2019-2020, Xperience AI, all rights reserved.
Third party copyrights are property of their respective owners.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- Neither the names of the copyright holders nor the names of the contributors may be used to endorse or promote products derived from this software without specific prior written permission.

This software is provided by the copyright holders and contributors "as is" and any express or implied warranties, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose are disclaimed. In no event shall copyright holders or contributors be liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including, but not limited to, procurement of substitute goods or services; loss of use, data, or profits; or business interruption) however caused and on any theory of liability, whether in contract, strict liability, or tort (including negligence or otherwise) arising in any way out of the use of this software, even if advised of the possibility of such damage.
(www.opencv.org)

Libtiff
Copyright (c) 1988-1997 Sam Leffler
Copyright (c) 1991-1997 Silicon Graphics, Inc.

Permission to use, copy, modify, distribute, and sell this software and its documentation for any purpose is hereby granted without fee, provided that (i) the above copyright notices and this permission notice appear in all copies of the software and related documentation, and (ii) the names of Sam Leffler and Silicon Graphics may not be used in any advertising or publicity relating to the software without the specific, prior written permission of Sam Leffler and Silicon Graphics.

THE SOFTWARE IS PROVIDED "AS-IS" AND WITHOUT WARRANTY OF ANY KIND, EXPRESS, IMPLIED OR OTHERWISE, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

IN NO EVENT SHALL SAM LEFFLER OR SILICON GRAPHICS BE LIABLE FOR

ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND,
OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS,
WHETHER OR NOT ADVISED OF THE POSSIBILITY OF DAMAGE, AND ON ANY THEORY OF
LIABILITY, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE
OF THIS SOFTWARE.

Qt
The Qt framework is licensed under the commercial Qt license.

Qwt
The Qwt library contains GUI Components and utility classes which are primarily useful for programs with a technical background. Beside a framework for 2D plots it provides scales, sliders, dials, compasses, thermometers, wheels and knobs to control or display values, arrays, or ranges of type double.
Qwt is distributed under the terms of the Qwt License, Version 1.0.

5.3   Copyright Information

By installing this software, you accept and agree to be bound by the terms of the software license agreement that appears below.

Copyright © Image Engineering GmbH & Co. KG, 2022

The software furnished under this agreement is provided on an "as is" basis, without any warranties or representations express or implied, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. It is solely the responsibility of the consumer to determine the software's suitability for a specific purpose or use. Image Engineering GmbH & Co. KG, and anyone else who has been involved in the creation, production, delivery, or support of this software, will in no event be liable for direct, indirect, special, consequential, or incidental damages resulting from any defect, error, or omission in the diskette or software or any other events, including, but not limited to, any interruption of service, loss of profits or goodwill, legal action or any other consequential damages. The user assumes all responsibility arising from using this software, for which Image Engineering GmbH & Co. KG shall have no liability, regardless of whether such use is lawful or foreseeable. Image Engineering GmbH & Co. KG shall have no liability for any data or programs stored by or used with this software, including the costs of recovering such data or programs. Image Engineering GmbH & Co. KG reserves the right to make corrections or improvements to the information provided and to the related software at any time, without notice.