ANALYZER by DXOMARK

Flare Measurement

Flare is an artifact of a lens response to a bright light, such as the sun. Although it can be used for artistic effect in photography, in many camera applications, flare is generally not desirable and can even cause damage.

DXOMARK has developed a new metric and measurement setup to evaluate the full physical characteristics of optical flare.

Standardization committees are currently studying DXOMARK flare metrics proposal and it is already part of IEEE P2020 draft standard.

Key features

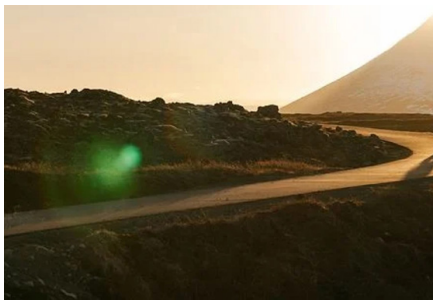
ANALYZER's flare measurement setup precisely characterizes lens flare.

- Intuitive metrics to help understand the amount of flare
- Stable, accurate and repeatable optical bench
- Light source simulating the sun by using a collimated light with a viewing angle smaller than 1°
- Automatic measurement to give the metrics and characterization of flare shape
- Measurement automation capability thanks to python API
- Used for IEEE-P2020 standard definition and verification

Available measurements

- 2D flare shape for a defined light source angle between -160° and +160°
- Evolution of the flare level as a function of the light source angle

AUTOMOTIVE APPLICATION



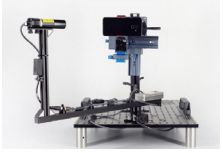
Lens flare is a well-known limitation of automotive cameras used for safety and autonomous driving. It can reduce contrast and dynamic range.

COMPASS SETUP

The flare measurement uses the COMPASS setup associated with a dedicated collimated light source.

DXOMARK's COMPASS is a multiple measurement setup composed of a camera holder set on a 6-axis alignment stage and an automated rotation arm that places a collimator at the desired angle.

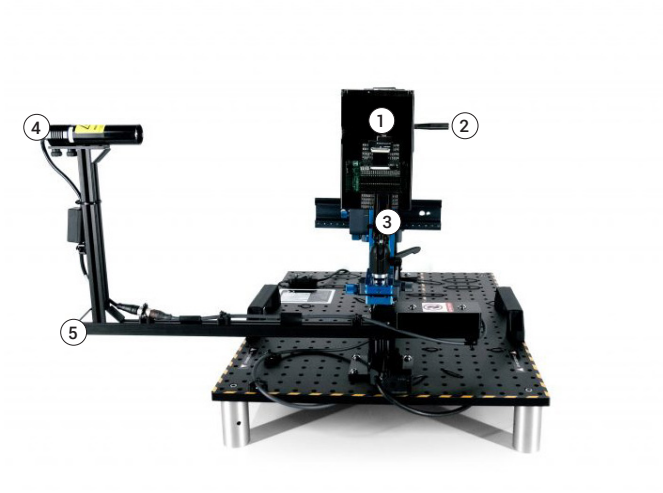
Several kinds of light sources and collimators can be placed on the COMPASS arm, depending on the required measurement (MTF at infinity, flare, etc.).



- Automated rotation of the collimated light source with high precision (0.03°).
- A Python API controls the arm's rotation to automate shooting from all angles.

FLARE MEASUREMENT HARDWARE

Flare Setup



① Device under test, ② Indexed rotation stage to change from horizontal to vertical and diagonal axis, ③ 6 axis alignment stage equipped with 1/4 in. ISO 1222 compatible screw, designed to support any camera and demoboard, ④ Collimated light source ⑤ Motorized arm for rotating the light source

Required equipment

COMPASS setup

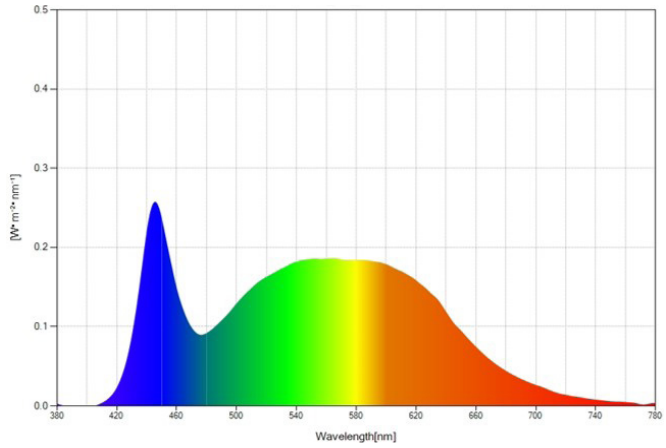
Flare collimated light source
(FLARE_SOURCE_001, FLARE_IR85_001 or FLARE_IR94_001)

Recommended equipment

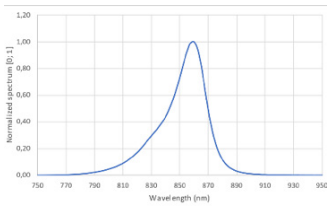
FRAMING & ACCESSORIES

Gossen Luxmeter - Mavolux 5032B

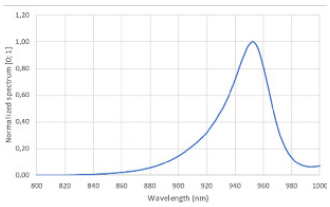
Light source specification



VIS Light source



850nm Light source

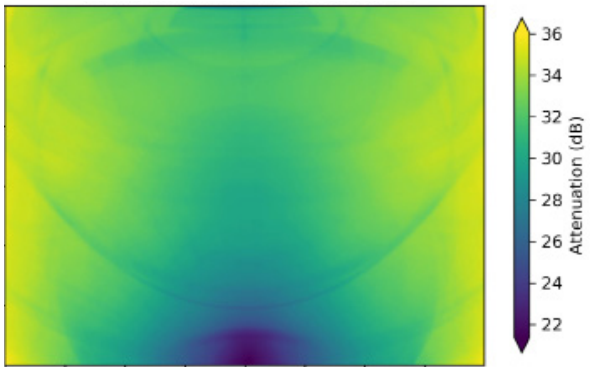


940nm Light source

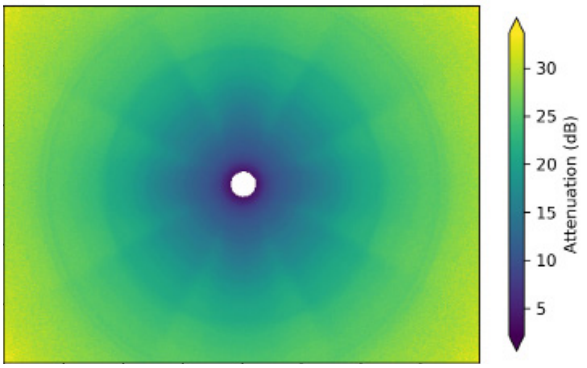
	VIS Light source	850nm Light source	940nm Light source
Light type	Collimated high-power LED	Collimated high-power LED	Collimated high-power LED
Color temperature	[5000; 5500] K	N/A	N/A
CRI	85	N/A	N/A
Peak wavelength	N/A	860nm	950nm
Centroid wavelength	N/A	850nm	940nm
Illuminance measured at lens surface	>10000 lx	>21 W/m²	>43 W/m²
Stability during time (for 1 hour of usage)	>98%	>99%	>98%
Apparent diameter of the light source (width)	0.95 °	0.9°	0.9°
Light beam diameter on the device under test at measurement position	25 mm	22 mm	22 mm
Virtual picture distance	Focus to infinity	Focus to infinity	Focus to infinity
Uniformity (Area of interest inside a 10 mm diameter circle concentric with the beam diameter on the DUT)	**98%**	**98%**	**98%**

Analyzer Workflow Manager provides Python functions for processing image files

Example of flare shape from a light source out of the field of view



Example of flare shape when the light source is at center of the field of view



Analyzer computes a flare attenuation map from each raw image captured by the camera under test during the flare test.

Using RAW images provides linear values for each pixel that can be converted to luminance received. These values are then compared with the illuminance received by the lens to compute the attenuation of the flare in the image field. (Please refer to DXOMARK's scientific paper, "Evaluation of the Lens Flare," for more details.)

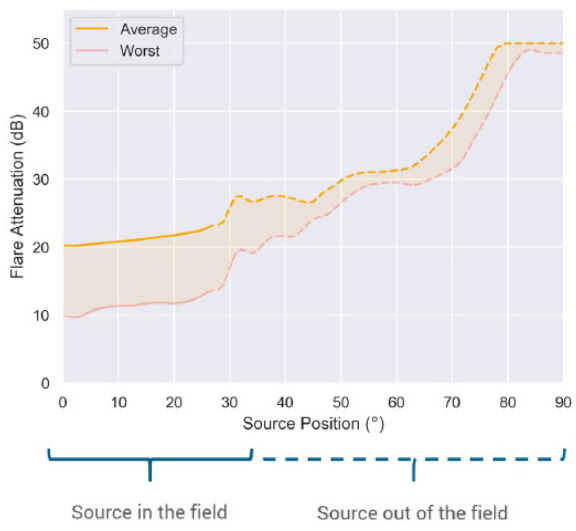
The flare attenuation map is computed with the flare source both inside and outside the camera's field of view.

When the light source is in the field of view, the light source itself is automatically removed from the computation.

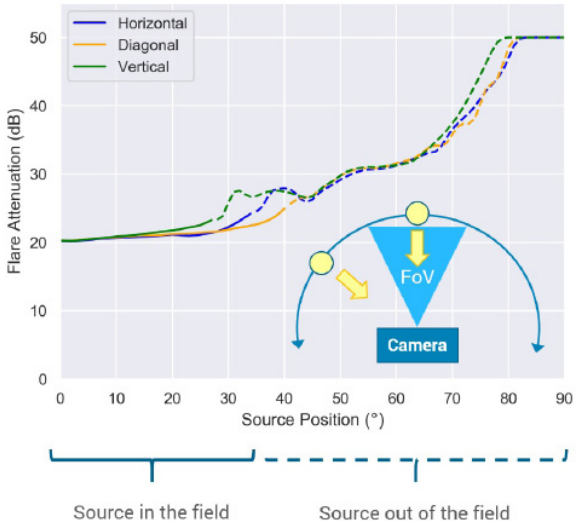
The COMPASS setup can easily change the rotation plan of the light source to cover all the solid angles.

The evolution of flare is computed from pictures taken of each position of the light source, and the results are aggregated in a graph:

Example of evolution of flare as a function of light source angle



Example of flare evaluation for 3 axes of the light source rotation



FLARE MEASUREMENT ACCURACY & SPECIFICATIONS

The Flare Bench setup ensures controllable and repeatable conditions for highly accurate measurements.

Accuracy on light source angular position	Light source variation	Flare maximum attenuation accuracy	Flare average attenuation accuracy
≤ 2 arcmin (0,03°)	≤2% during 1 hour	≤1 dB	≤1 dB

Specifications

CAMERA TESTING

Min resolution: VGA
Max resolution: up to 200Mpix
FOV: up to 240°, with no limitation for the lens distortion
Focal length: under 200mm (35mm equivalent)
Spectral sensitivity: measurements are designed for visible spectrum cameras
Sensor: Bayer filter sensor
File formats:
Images: RAW formats (latest release notes provides a list of supported RAW formats)

PLATFORM REQUIREMENTS

PC-type computer with the following minimum configuration:
– **Intel Core i5 Fifth generation® processor** or higher,
– A version of **Windows 10® 64 bits** operating system,
– **4 GB of RAM** or more,
– At least **64 GB of free disk space** to operate the software,
– **A video card with 3D driver**, compatible with DirectX 12 and OpenGL 3.0 (in Remote Desktop or Virtual Machines you may experience graphical glitches depending on the renderer used),
– **1440×800** or more VGA monitor, using a maximum of 125% DPI scaling,
At least **three USB ports**

LABORATORY REQUIREMENTS

Laboratory minimum size: 2 x 2m
Temperature: 23°C ± 2°C (ISO 554:1976)
Humidity: 50% ± 20% (ISO 554:1976)

REFERENCES

- Elodie Souksava, Thomas Corbier, Yiqi Li, François-Xavier Thomas, Laurent Chanas, Frédéric Guichard
«Evaluation of the Lens Flare» in Proc. IS&T Int'l. Symp. on Electronic Imaging: Image Quality and System Performance XVIII, 2021, pp 215-1 - 215-7
- Elodie Souksava, Emilie Baudin, Claudio Greco, Hoang-Phi Nguyen, Laurent Chanas, and Frédéric Guichard
«Improvement of the flare evaluation and applications in NIR» will be presented at Electronic Imaging 2023
- IEEE P2020: Draft Standard for Automotive System Image Quality, https://www.techstreet.com/ieee/standards/ieee-p2020?gateway_code=ieee&vendor_id=6765&product_id=2505612