

Flare is an artifact of a lens's 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.

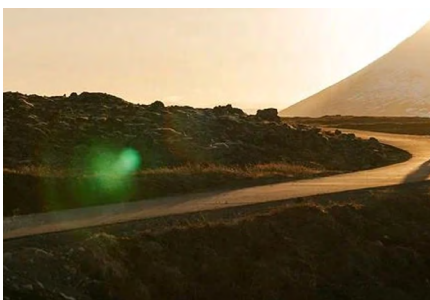
The ISO committee is currently studying DXOMARK's proposed flare metrics and measurements with the aim of establishing them as a new IEEE/P2020 standard.

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

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.

Available measurements

- ≡ 2D flare shape for a defined light source angle
- ≡ Evolution of the flare level as a function of the light source angle

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.

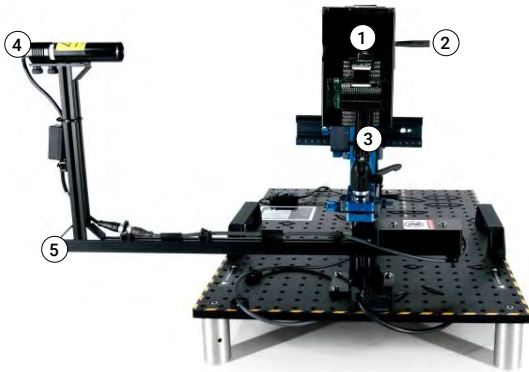
Several kinds of light sources and collimators can be placed on the COMPASS arm, depending on the required measurement (MTF at infinity, flare, etc.).



- 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, 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

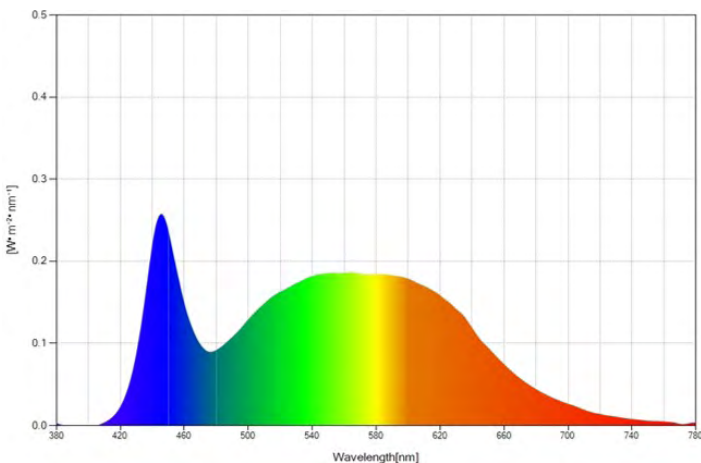
Recommended equipment

FRAMING & ACCESSOIRES



Gossen Luxmeter
- Mavolux 5032B

Light source specification



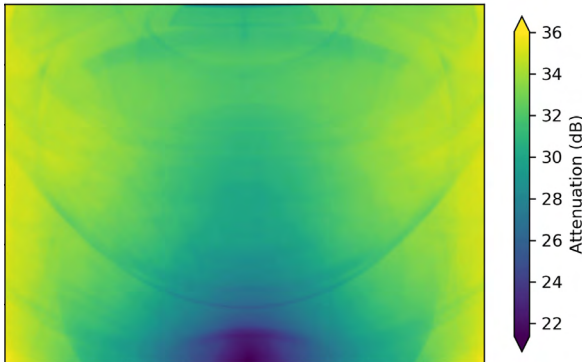
Spectrum of the light source

Light type	Collimated high-power LED
Color temperature	[5000; 5500] K
CRI	85
Illuminance measured at lens surface	>10000 lx
Stability during time (for 1 hour of usage)	>98%
Apparent diameter of the light source (width)	0.95°
Light beam diameter on the device under test at measurement position	25 mm
Virtual picture distance	Focus to infinity
Uniformity (Area of interest inside a 10 mm diameter circle concentric with the beam diameter on the DUT)	98%

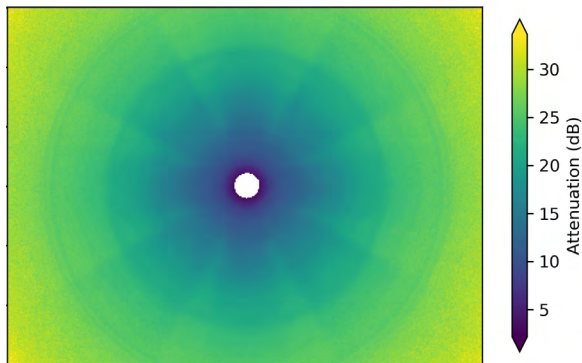
FLARE MEASUREMENTS SAMPLES

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.)

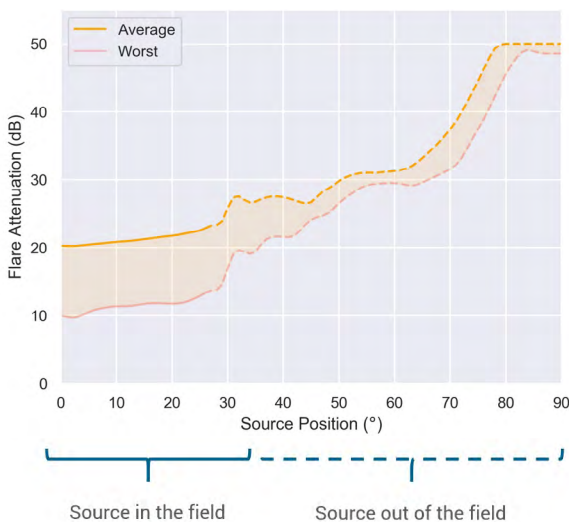
The flare attenuation map is computed with the flare source both inside and outside the camera's field of view.

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

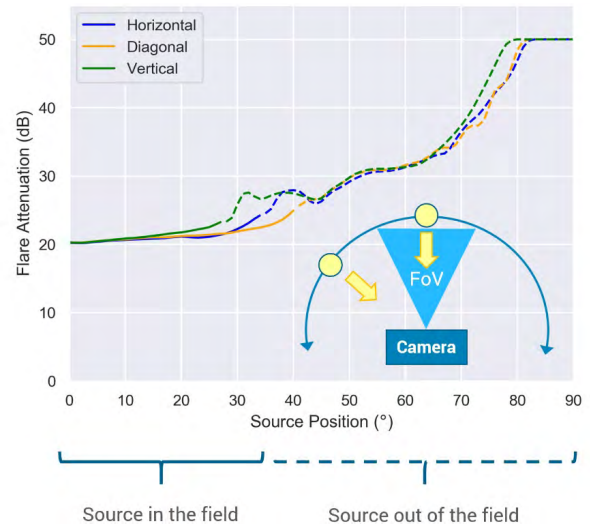
The COMPASS setup can easily change the rotation plan of the light source to cover all the solid angles.

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 Pentium IV @ processor or higher

Windows 10

2 GB of RAM or more

At least 30 GB of free disk space to operate the software

A video card with 3D driver, compatible with DirectX 12

1024 x 768 or more

At least one USB port

It is possible to run Analyzer on a virtual computer (such as running on a Mac platform, for instance), or to control it remotely. Depending on the selected remote OS, Analyzer may not generate certain graphics.

LABORATORY REQUIREMENTS

Laboratory minimum size: 2 x 2m

Temperature: 23°C ± 2°C (ISO 554:1976)

Humidity: 50% ± 20% (ISO 554:1976)

REFERENCES

Evaluation of the Lens Flare – Electronic Imaging | 2021