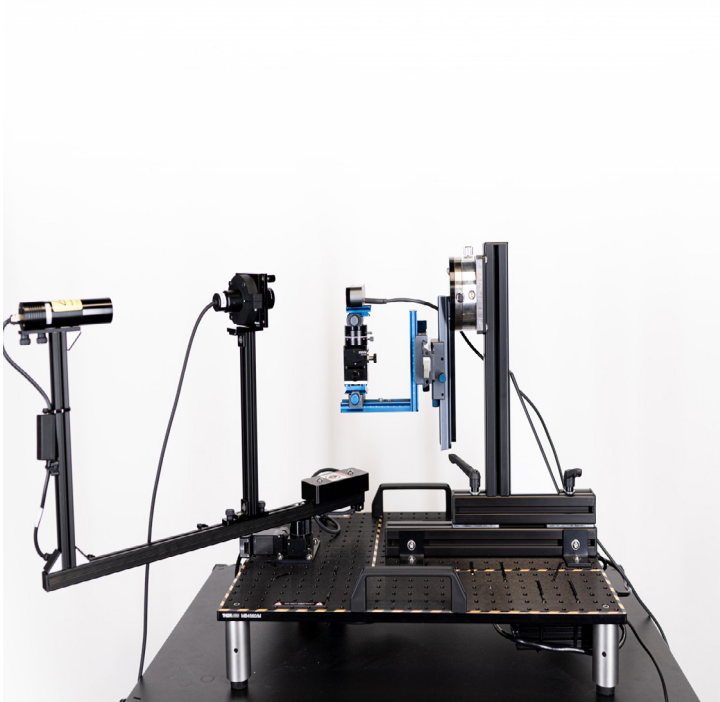


Optimizing a long-range camera requires an impossibly deep lab. However, our new compass automated testing bench lets you compute mtf measurements at infinity on the axis and for the whole field of view (up to 240°), and can be used to evaluate flare as well.



### COMPASS setup

The collimator MTF measurement uses the COMPASS setup associated with a dedicated collimator to perform the MTF evaluation.

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

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

Automated rotation of the collimated light source with a high precision of 0.03°.

Shoots at all angles canbe automated thanks to a Python API for controllingthe arm rotation.

### Key features

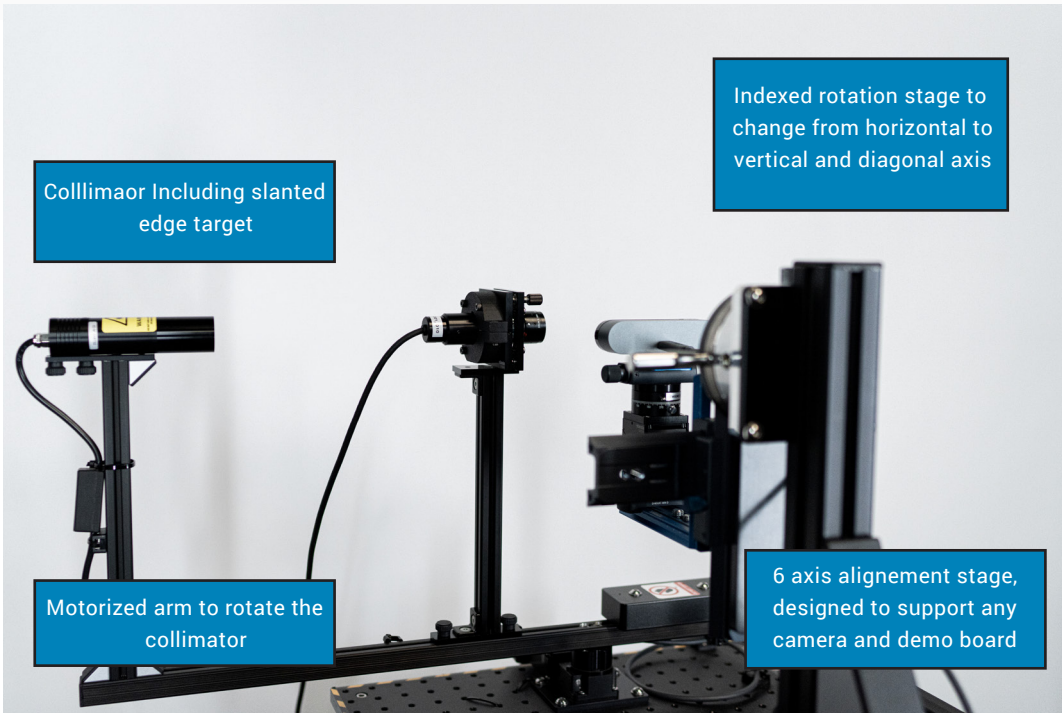
- Easy, fast and repeatable characterization of sharpness for all positions in the field, thanks to the compass setup table, accurate motorized optical bench
- Automatically detects relevant test chart patterns and reports results with no operator intervention
- Performs measurements on RGB images (.jpeg, .tiff, etc.)
- Python API provides measurement automation capability
- Can measure cameras with resolutions from 1280 x 720 to 50 Mpix, and fields of view up to 240°

### Available measurements

- Sagittal and tangential sharpness metrics for each collimator position in the field
- Evolution of sharpness metrics in the field

MTF COLLIMATOR MEASUREMENT HARDWARE

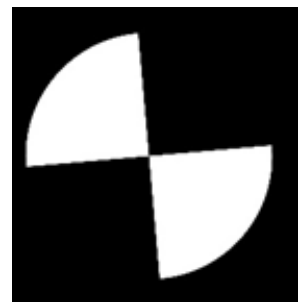
Collimator on COMPASS setup



Required equipment

- \* COMPASS\_001 setup
- \* COL50\_001
- \* COL100\_001w

Slanted edge target:



<b>Focal length</b>	50 mm	100 mm
<b>Aperture</b>	f/2.8	f/3.3
<b>Slanted edge target size</b>	Ø12mm	Ø12mm
<b>Controller power input</b>	24 V/DC, 1A	90/260 V/AC, 250mA
<b>Light type</b>	Adjustable LED	Adjustable LED
<b>Color temperature</b>	6200 K	6200 K
<b>FOV*</b>	10 °	6°
<b>Maximum frequency**</b>	>2cy / arcmin	>4 cy / arcmin

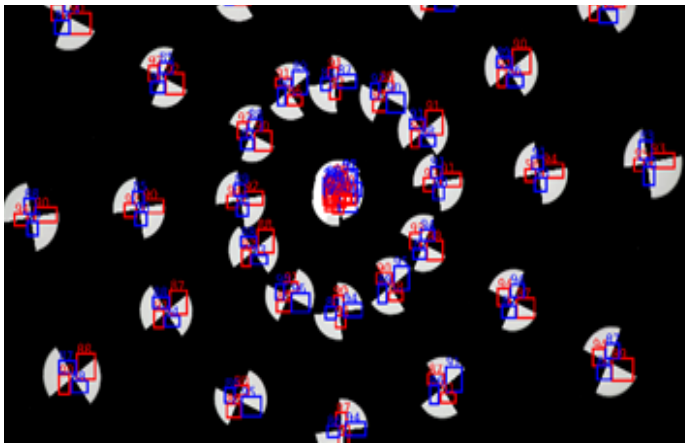
\* FOV means the size of the target as viewed by the camera

\*\* The maximum frequency is the guaranteed maximum angular frequency of the camera to achieve accurate mtf measurements. For instance, a Full HD camera with a diagonal field of view of 120° will have a maximum resolution of 0.1 cycle/arc minute.

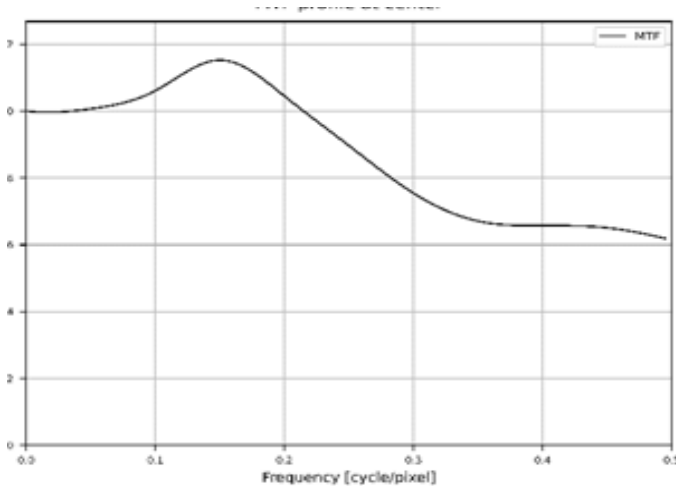
MTF COLLIMATOR MEASUREMENT SAMPLES

**Analyzer Workflow Manager provides Python functions for processing image files**

Example of synthetic fusion of collimator captures at different positions in the field, with regions of interest automatically detected



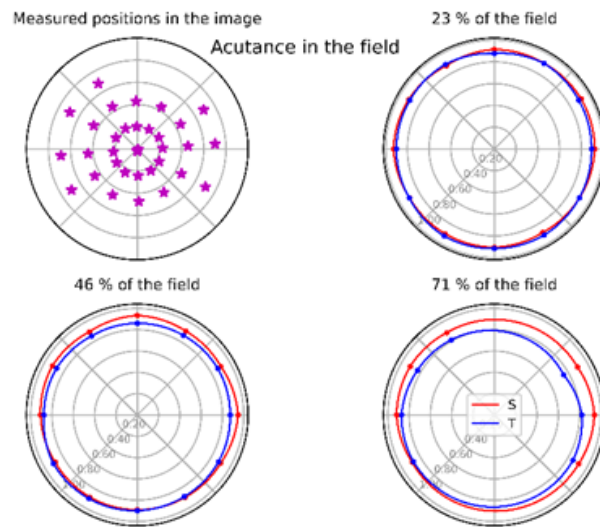
Example of MTF profile at center of the field



MTF profile for sagittal and tangential directions can be obtained for each position of the collimator in the field.

The evolution in the field of MTF related metrics can be computed and aggregated in the following type of graphs.

Example of acutance in the field measurement:



In this example, a loss in acutance is visible between the center part of the field and the outer part. Tangential metrics are also falling faster than Sagittal ones.

Compliance with standards:  
MTF measurement is compliant with ISO 12233 and IEEE-CPIQ P1858.

MTF COLLIMATOR MEASUREMENT ACCURACY & SPECIFICATIONS

For MTF curves, the measurement repeatability is  $\pm 4\%$  on average, with higher accuracy at lower frequencies, as shown in this table:

Frequency (cy/pixel)	Accuracy (RGB)
[0;0.1]	$\pm 2\%$
[0.1;0.3]	$\pm 4\%$
[0.3;0.5]	$\pm 7\%$

Repeatability of acutance measurements is  $\pm 0.04$ . However, this depends on the measured camera characteristics (autofocus accuracy and repeatability, mechanical vibrations).

The collimator on the COMPASS setup ensures repeatable conditions, allowing very good accuracy for the measurement:

Accuracy on collimator angular position is  $\pm 2$  arcmin ( $0.03^\circ$ ), and the collimator’s light source illumination stability is over 95% for at least 30 minutes.

**Specifications:**

Camera testing specifications  
 Min resolution: VGA  
 Max resolution: up to 50Mpix  
 FOV: up to 240°, with no limitation for lens distortion  
 Focal length: under 200 mm (35 mm equivalent)  
 Spectral sensitivity : measurements have been designed for visible-spectrum cameras Bayer filter sensor  
 File formats: jpeg, bmp, png, tif.

**Platform requirements:**

PC-type computer with the following minimum configuration:  
 Intel Pentium IV @ processor or higher  
 Operating systems: Windows® 10 or higher  
 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  
 Screen resolution 1024 x 768 or higher  
 At least three USB ports  
 NB: It is possible to run Analyzer on a virtual computer (i.e., on a Mac platform, for instance), or to control it remotely. Depending on the selected remote OS, however, some graphics may not be generated.

**Laboratory requirements:**

Laboratory minimum size: 2 x 2 m  
 Temperature:  $23^\circ\text{C} \pm 2^\circ\text{C}$  (ISO 554:1976)  
 Humidity:  $50\% \pm 20\%$  (ISO 554:1976)