
optotune

# Optotune ELM-35-3.2-18-C

## Test report

November 2025

Amir Saba, Application Engineer

Optotune Switzerland AG | Bernstrasse 388 | CH-8953 Dietikon | Switzerland
Phone +41 58 856 3121 | www.optotune.com | info@optotune.com

# Summary

- **Working distance (WD) range of 200mm-Inf (Shorter WD possible)**
- **Performance close to the Nyquist rate of 2.74µm pixel size**
  Resolution >170 lp/mm for center of the image across the WD tuning range
  Resolution >=140 lp/mm across the field and WD tunning range
- **FP-sensitivity: 200mm-Inf WD with only 4.1dpt range**
- **Very negligible field curvature and distortion**
  Distortion is <1%
- **Negligible vignetting (~20%)**
- **10% resolution degradation due to the gravity-coma for horizontal optical axis**
- **Very good polychromatic performance**
  Performance very similar between white and blue backlights

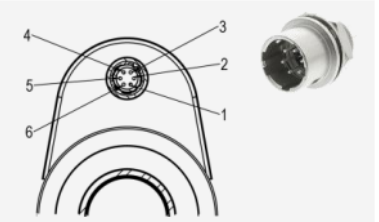
# ELM-35-3.2-18-C Datasheet

| Lens module specifications | | EL-12-30-TC-VIS-16D | EL-7-20-TC-VIS-14D | |
|---|---|---|---|---|
| Effective focal length | | 34.5 | | mm |
| F/# (fixed) | | 3.2 | 5.4 | |
| Maximum sensor format | | 1.1 | | inch |
| Maximum image circle (Φ) | | 18 | | mm |
| Lifecycles (10-90% sinusoidal) | | >1'000'000'000 | | cycles |
| FOV for 1.1" sensor | Diagonal | 28.9 | | ° |
| | Horizontal | 20.5 | | ° |
| | Vertical | 20.5 | | ° |
| Back focal length (BFL) | | 13.53 | | mm (in air) |
| Optical distortion | | <0.27 | <0.22 | % |
| Pixel size (recommended) | | 2.74 | | µm |
| Wavelength range | | 420-900 | | nm |
| Relative illumination | | >92 | >90 | % |
| Max chief ray angle | | 3.1 | 3.5 | ° |
| Working distance (WD) range[1] | | 200 to inf | | mm |
| Optimal WD | | 500 | | mm |
| WD at 0 dpt | | 1980 | | mm |
| Mount | | C-mount | | |
| Filter thread | | M31.5x0.5 | | |
| Connector type | | Hirose (6 pins) | | |
| Total track length (TTL) | | 130.75 | | mm |
| Dimension (Φ x L) | | 47.0 x 113.2 | | mm |
| Weight | | 470 | | g |
| Operating temperature | | -20 to +65 | | °C |
| Storage temperature | | -40 to +85 | | °C |

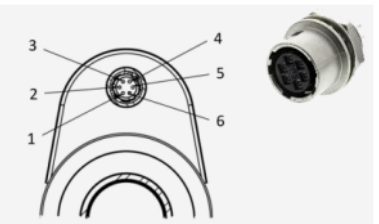
| Focus tunable lens specifications | EL-12-30-TC-VIS-16D | EL-7-20-TC-VIS-14D | |
|---|---|---|---|
| Focal power range (@25°C) | -6 to +10 | -6 to +8 | dpt |
| Focal power range for module WD range | -0.5 to 3.7 | | dpt |
| Temperature sensor and EEPROM | Yes | | |
| Control current (typical) | -250 to +250 | | mA |
| Max. control current | -300 to +300 | | mA |
| Motor coil resistance @ 30°C | 15 | 12 | Ω |
| Absolute maximum voltage (coil) | 6 | 6 | V |

## Electrical layout

| Hirose connector (HR10G-7R-6PB) | Function | Sensor pins |
|---|---|---|
| Pin 1 | Control current + | - |
| Pin 2 | Control current - | - |
| Pin 3 | Ground | 1-4 |
| Pin 4 | Vcc (3.0-3.7V) | 8 |
| Pin 5 | I²C SCL | 6 |
| Pin 6 | I²C SDA | 5 |




| Hirose connector (HR10G-7R-6SB) | Function | Value |
|---|---|---|
| Pin 1 | GPIO Trigger | - |
| Pin 2 | Analog In | 0-10V |
| Pin 3 | UART Tx / I²C SCL | TTL |
| Pin 4 | UART Rx / I²C SDA | TTL |
| Pin 5 | GND | - |
| Pin 6 | Vcc | 5-24V |

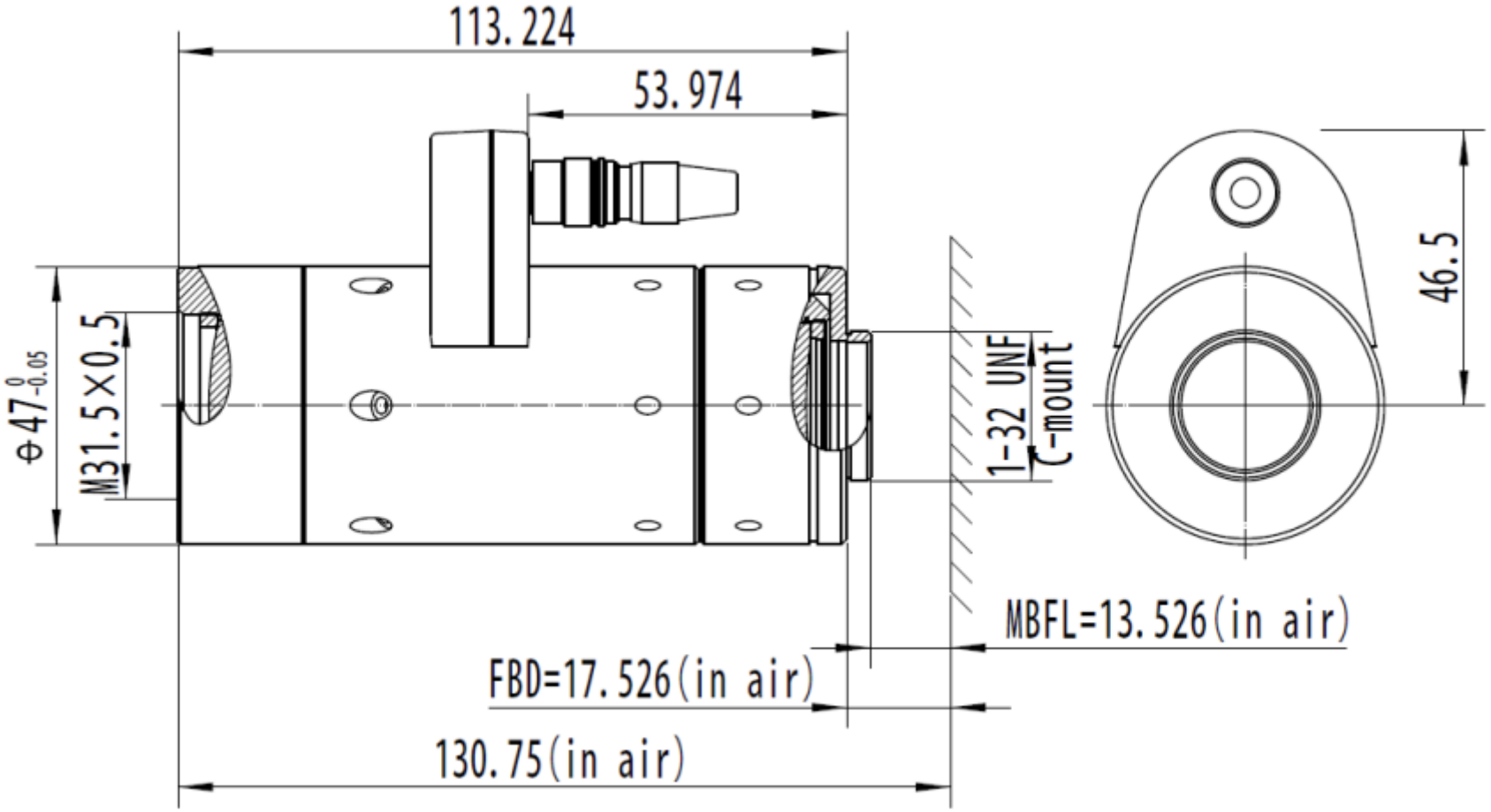






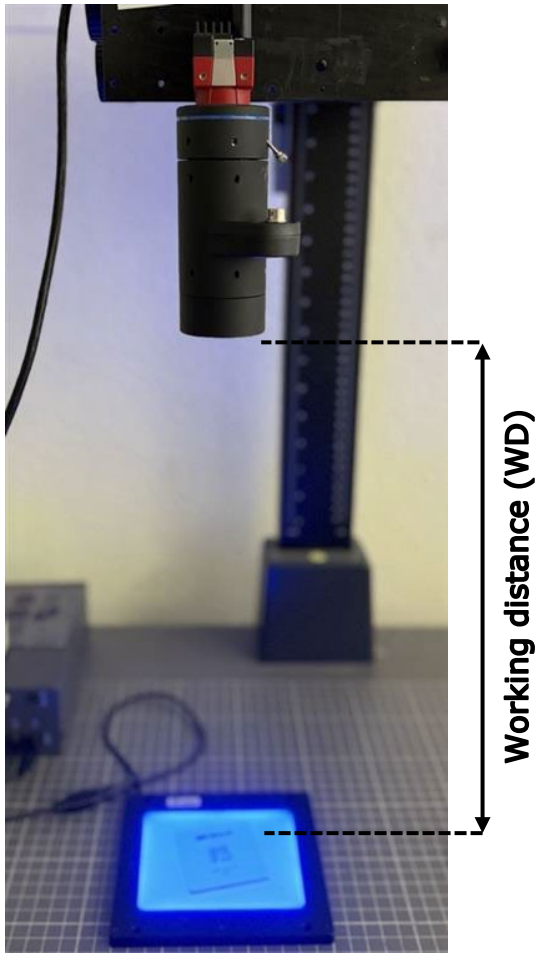
optotune

# Mechanical drawing



# Test Setup

| | |
|---|---|
| **Camera:** | Alvium 1800 C-2040<br>1.1" 4512 x 4512 px<br>Pixel size = 2.74 µm<br>Nyquist rate = 182 lp/mm<br>C-mount |
| **Lens:** | ELM-35-3.2-18-C |
| **Tunable lens:** | EL-12-30-TC-VIS-16D<br>SN: CGAM0024 |
| **Orientation:** | Vertical Optical Axis |
| **Driver:** | ECC-1C<br>SN:CXAB1458, FW: 2.0.741648 |
| **Target:** | USAF chrome target, positive |
| **Light:** | White backlight (LED1-FLS-110x110W)<br>Blue backlight |



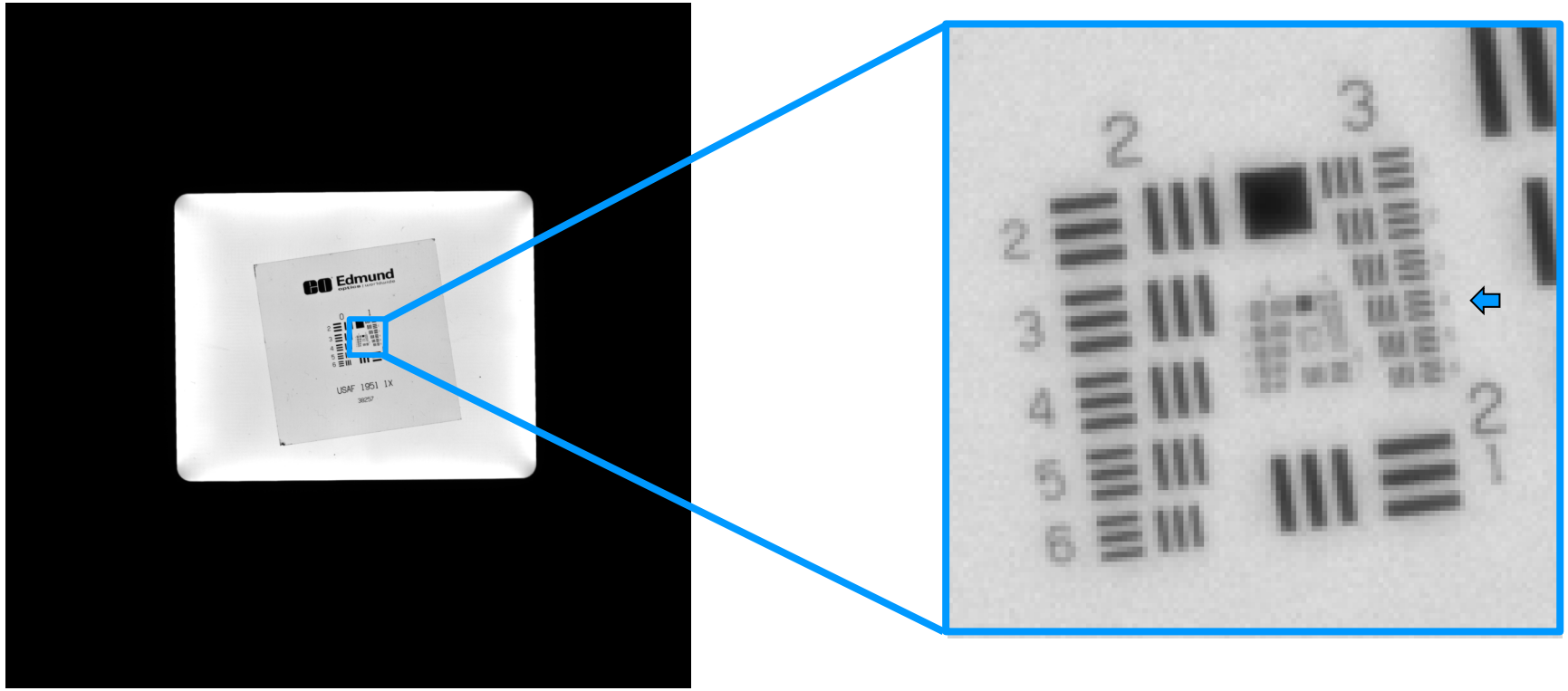
# Field of view with 1.1” sensor


Image size (2.74 µm pixel size):

- Width = 12.4 mm
- Height = 12.4 mm
- Diagonal = 17.5 mm

# Image evaluation

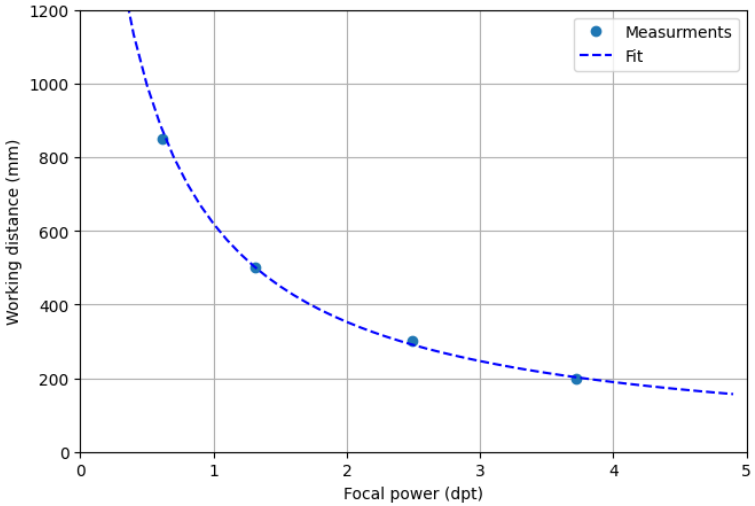
- All the images are taken at Gain 0, and without gamma correction
- The intensity of illumination is controlled to adjust the histogram of the images
- After acquisition, images are zoomed in to show the resolution-limited element



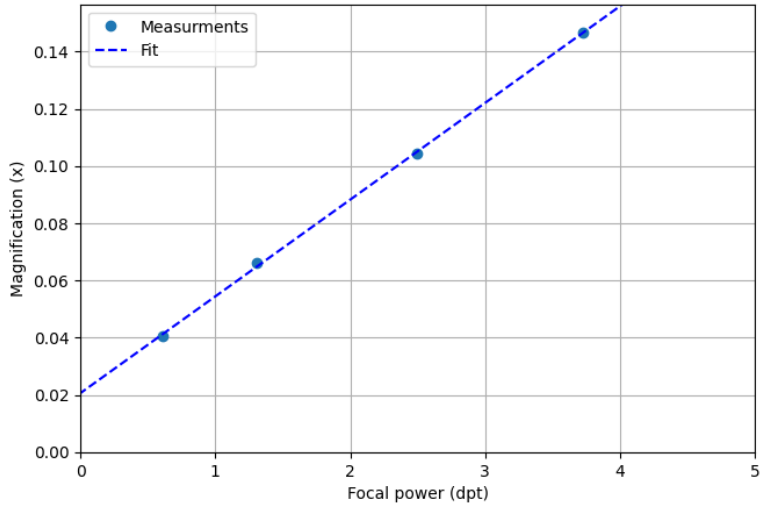
# Working distance, Magnification

- Magnification and working distance of this ELM is very well aligned with an ento-centric lens

Working distance




Magnification

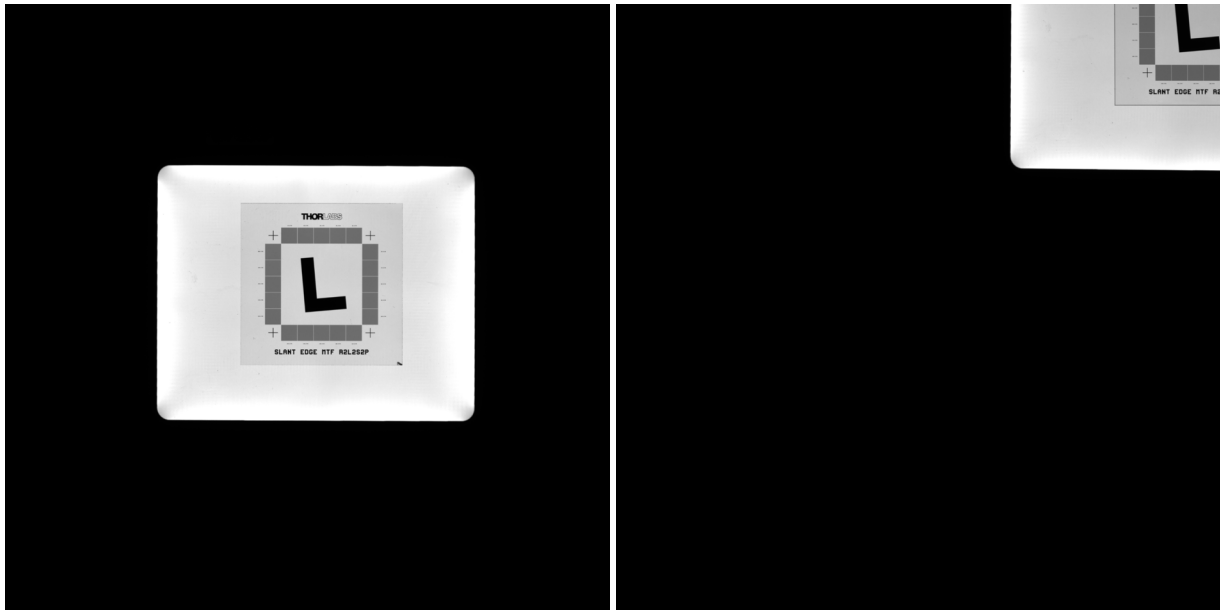



* Measured with blue LED backlight
* Magnification measured at the center of the image

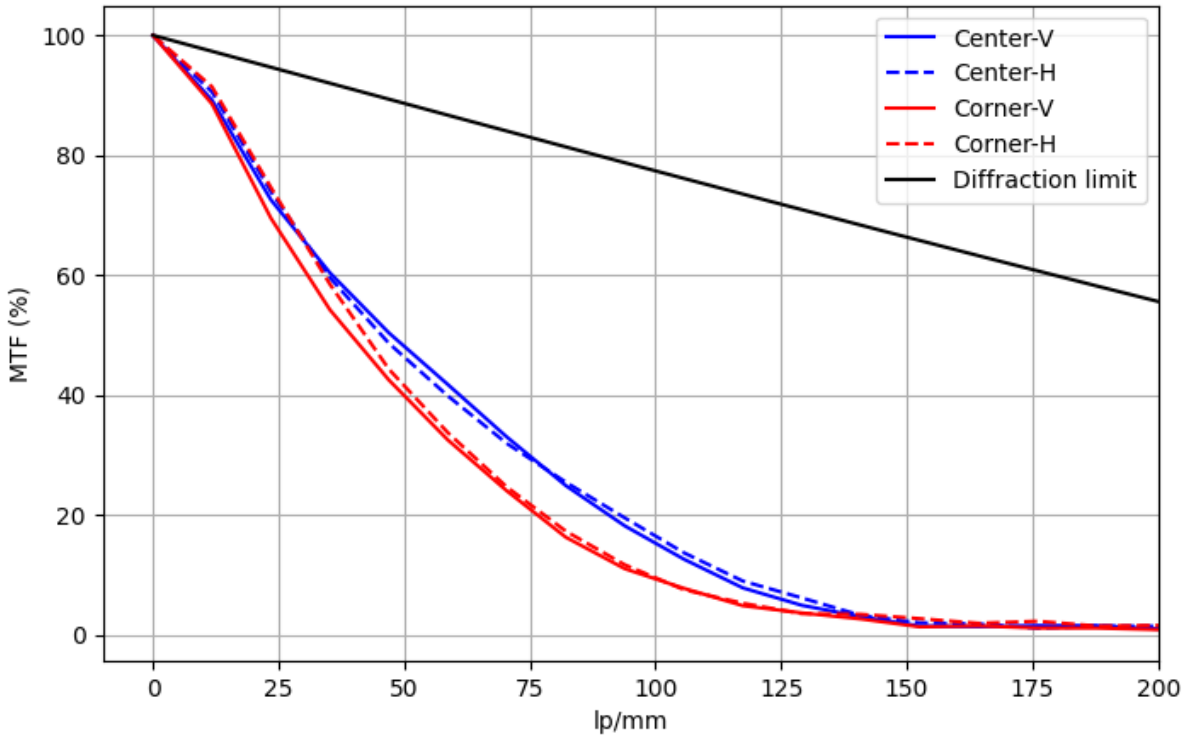
# Slanted-Edge MTF

Center

Corner



*Images taken with the blue LED at WD 500mm



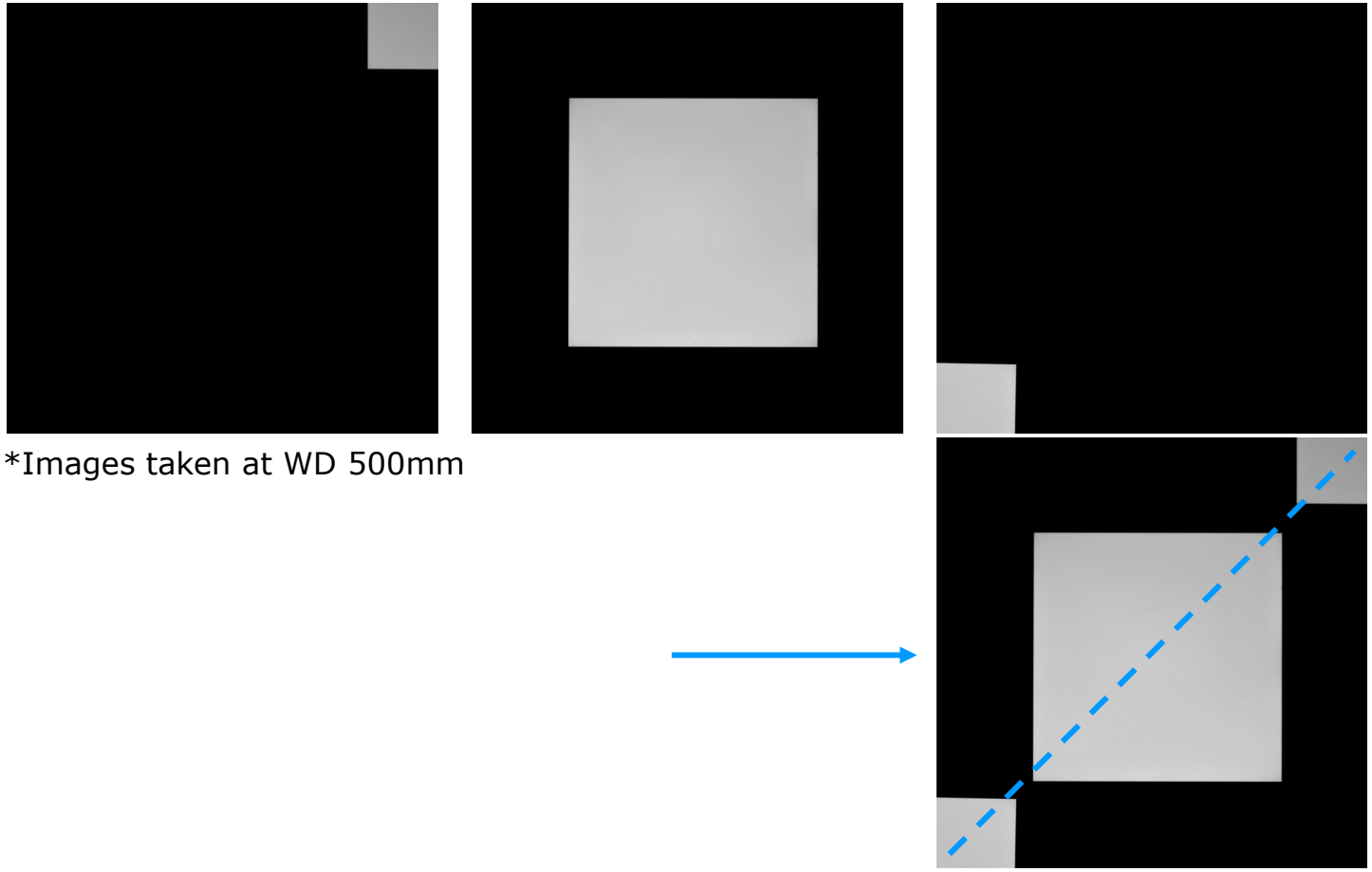




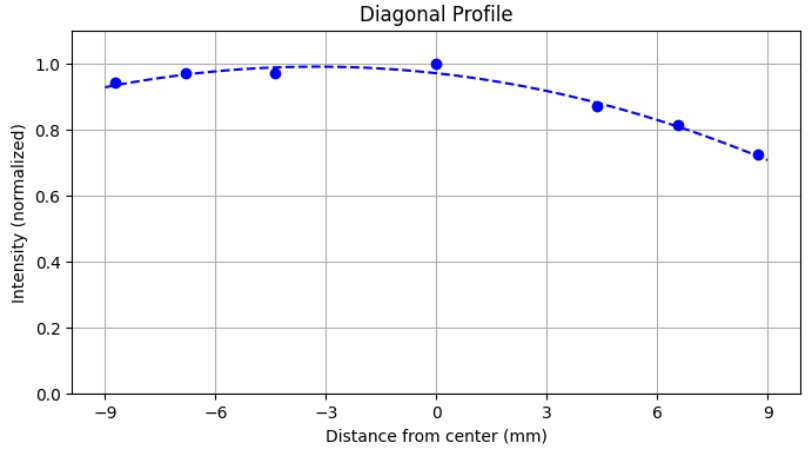
optotune

# Relative illumination

- Due to the wide-angle FOV, we did image stitching for multiple measurements with a uniform LED
- Relative illumination of this ELM is 0.32EV (20%) for 1.1” sensor
- There is a negligible dependence to the focal power/WD for the vignetting

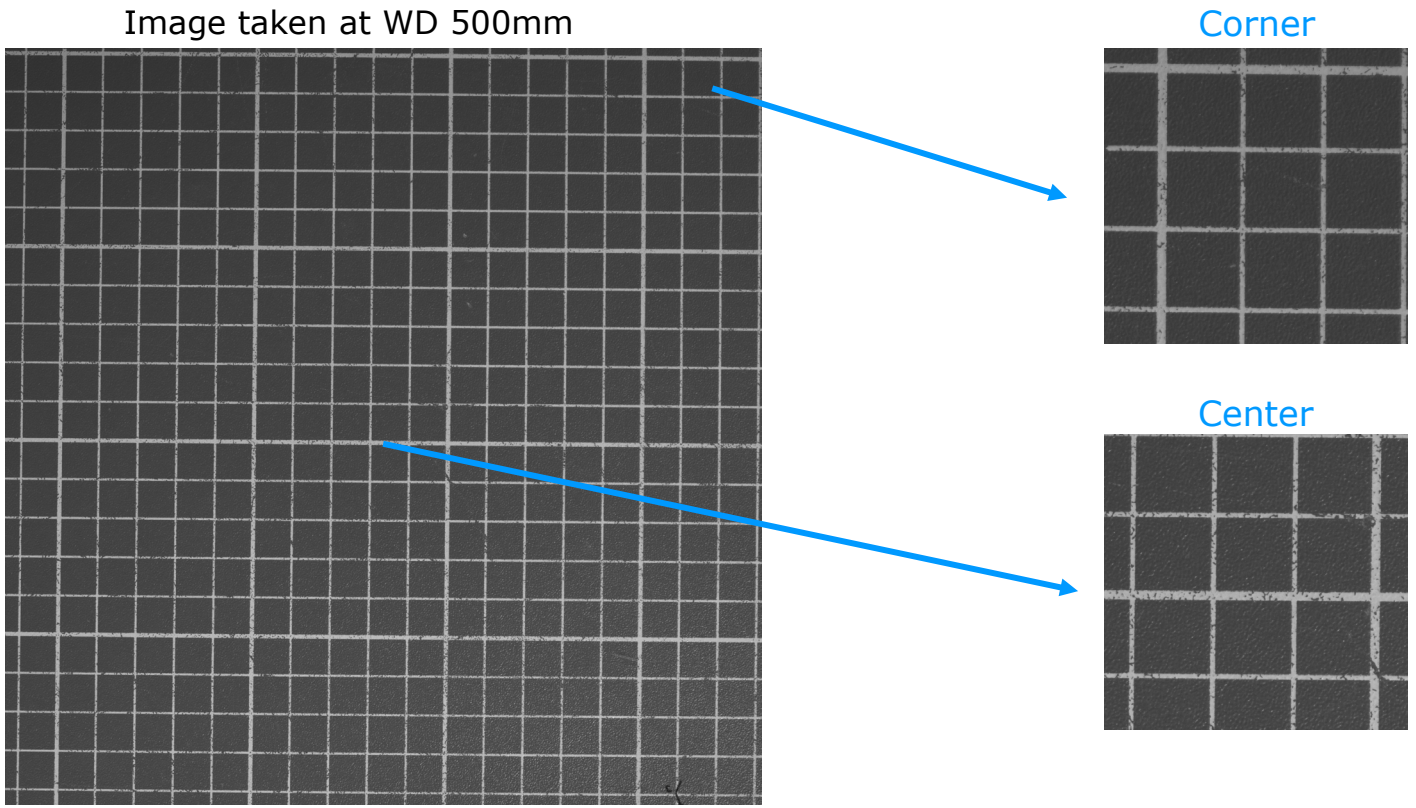


*Images taken at WD 500mm



# Distortion and field curvature

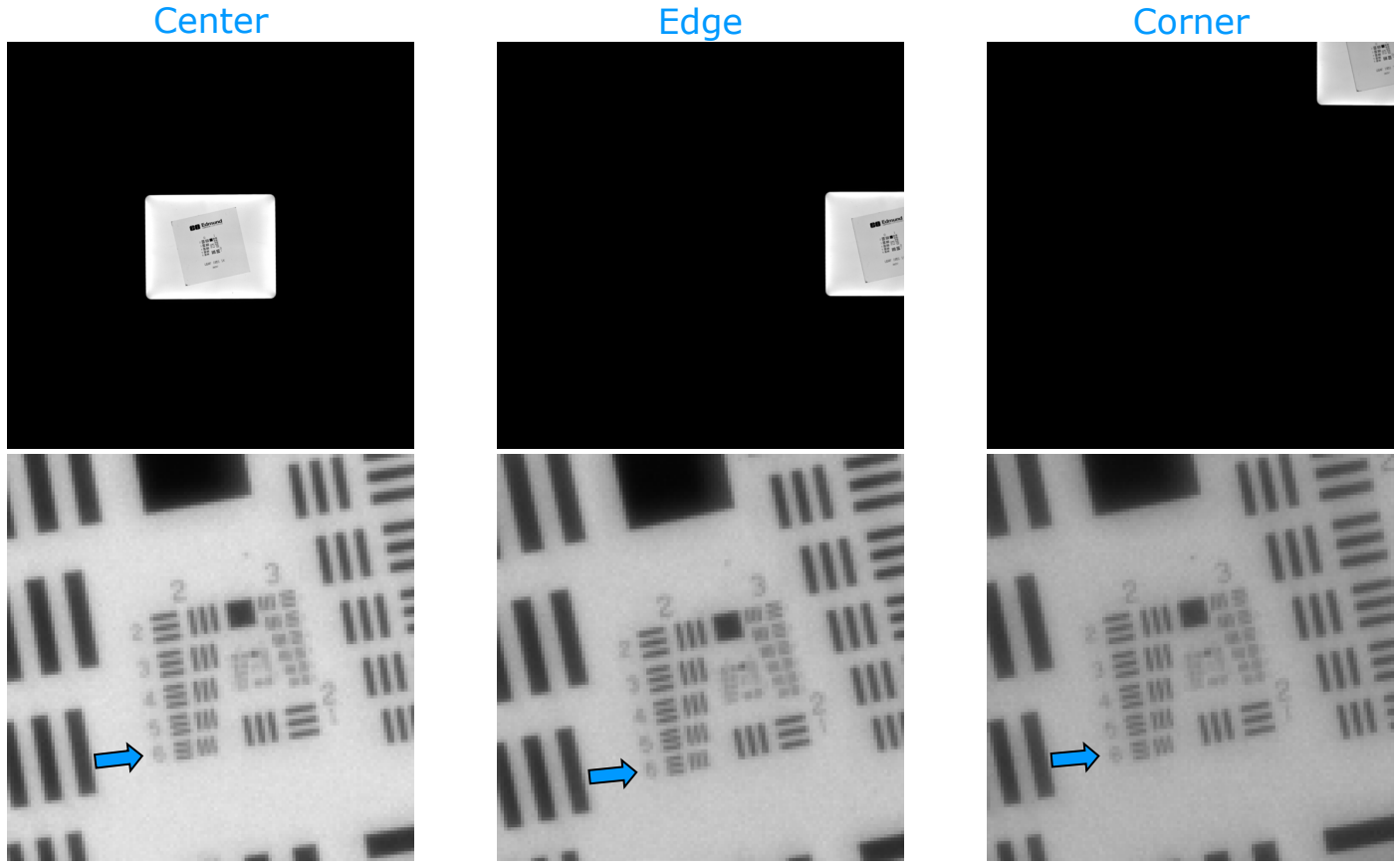
- We see some distortion but no field curvature
- Geometrical distortion value: **<1%**



# WD 850 mm: +0.61dpt, Blue light
# Performance is close to Nyquist limit

**Camera**
Sensor size = 4512 x 4512 px
Pixel size = 2.74 um
Nyquist limit = 182 lp/mm

**Light**
Blue background illumination




| | Center | Edge | Corner |
|---|---|---|---|
| USAF element: | 2/6 | 2/6 | 2/6 |
| Line width (um): | 70.15 | 70.15 | 70.15 |
| Lp/mm (object): | 7 | 7 | 7 |
| Magnification: | 0.041 | 0.041 | 0.041 |
| **Lp/mm (image):** | **174** | **174** | **174** |

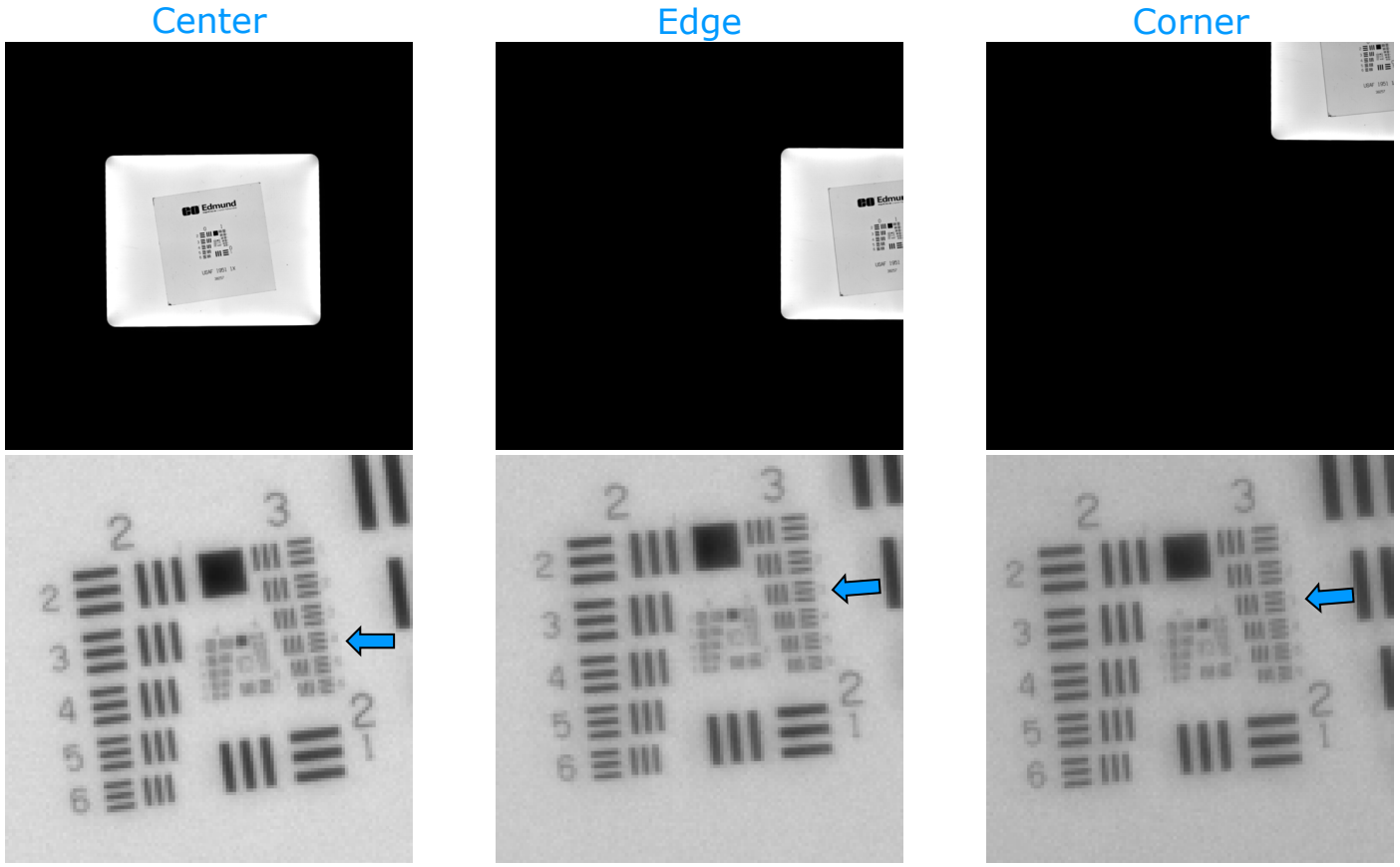


optotune

# WD 500 mm: +1.31dpt, Blue light
# Performance is close to Nyquist limit

**Camera**
Sensor size = 4512 x 4512 px
Pixel size = 2.74 um
Nyquist limit = 182 lp/mm

**Light**
Blue background illumination




| | Center | Edge | Corner |
|---|---|---|---|
| USAF element: | 3/4 | 3/3 | 3/3 |
| Line width (um): | 44.19 | 49.61 | 49.61 |
| Lp/mm (object): | 11 | 10 | 10 |
| Magnification: | 0.066 | 0.066 | 0.066 |
| **Lp/mm (image):** | **171** | **152** | **152** |

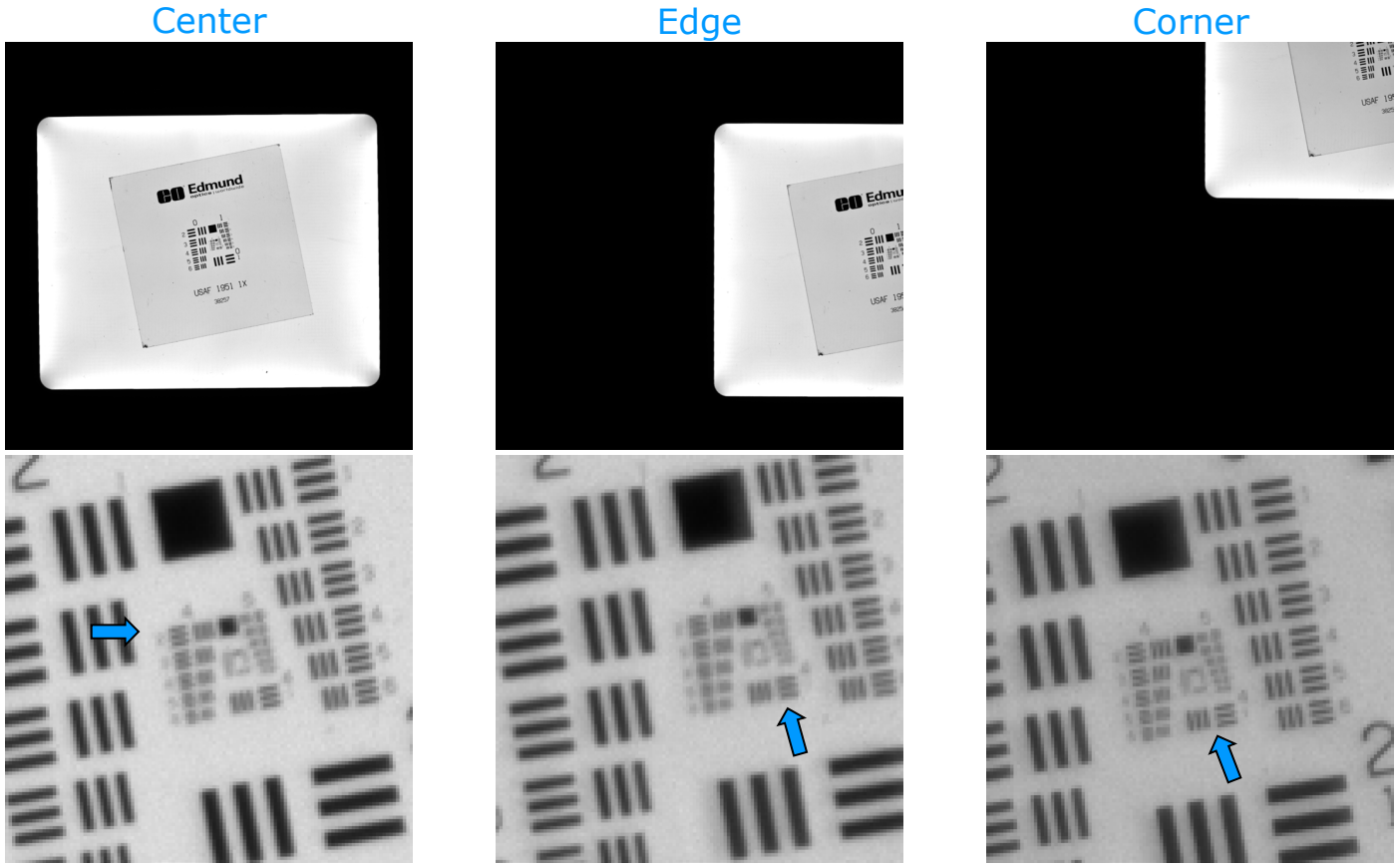


optotune

# WD 300 mm: +2.49dpt, Blue light
# Performance is close to Nyquist limit

**Camera**
Sensor size = 4512 x 4512 px
Pixel size = 2.74 um
Nyquist limit = 182 lp/mm

**Light**
Blue background illumination




| | Center | Edge | Corner |
|---|---|---|---|
| USAF element: | 4/2 | 4/1 | 4/1 |
| Line width (um): | 27.84 | 31.25 | 31.25 |
| Lp/mm (object): | 18 | 16 | 16 |
| Magnification: | 0.104 | 0.104 | 0.104 |
| **Lp/mm (image):** | **172** | **153** | **153** |

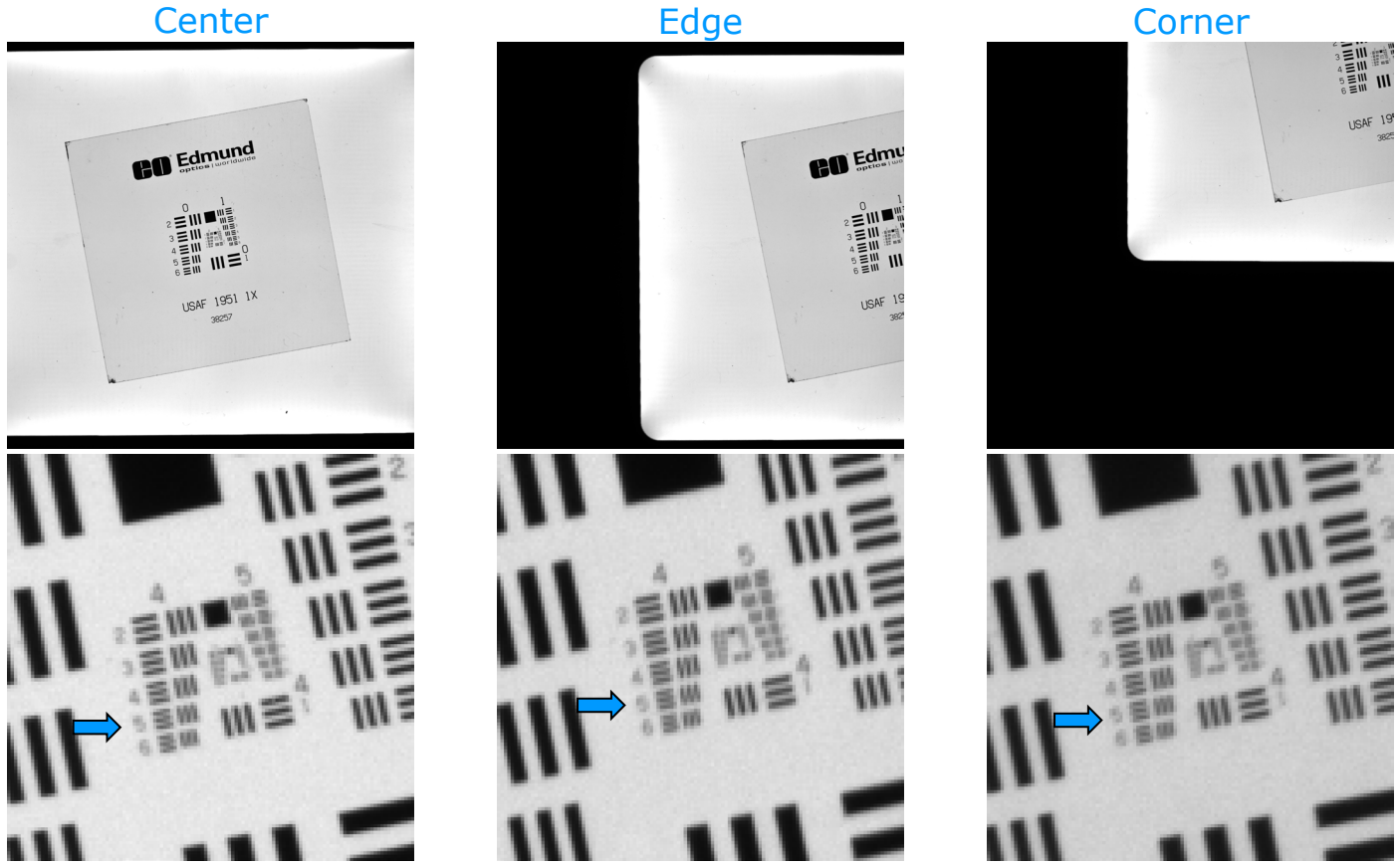


optotune

# WD 200 mm: +3.72dpt, Blue light
# Performance is close to Nyquist limit

**Camera**
Sensor size = 4512 x 4512 px
Pixel size = 2.74 um
Nyquist limit = 182 lp/mm

**Light**
Blue background illumination



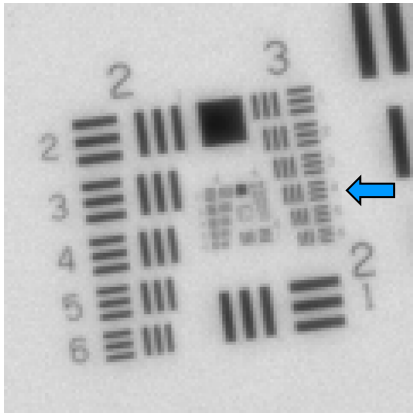
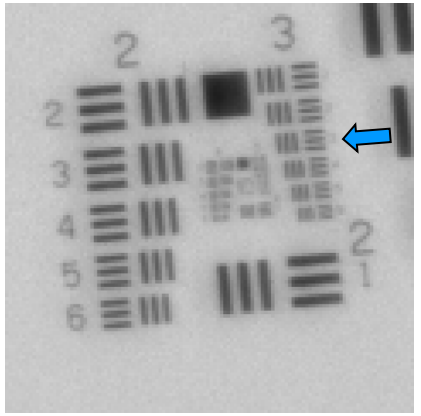
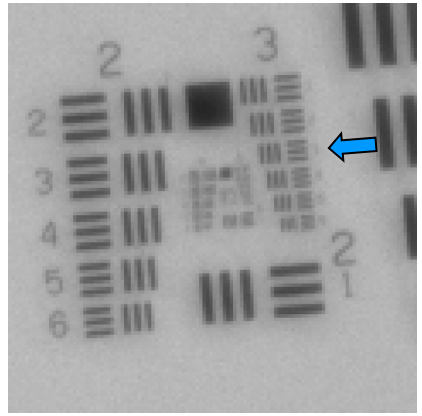
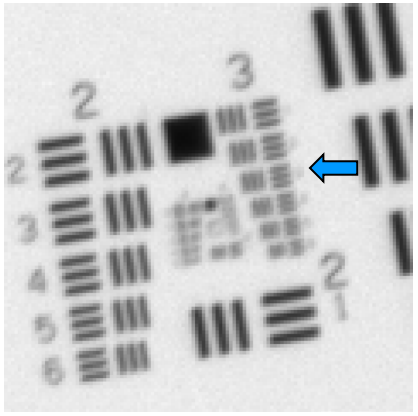
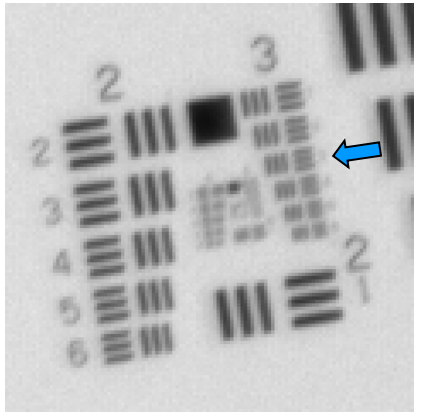
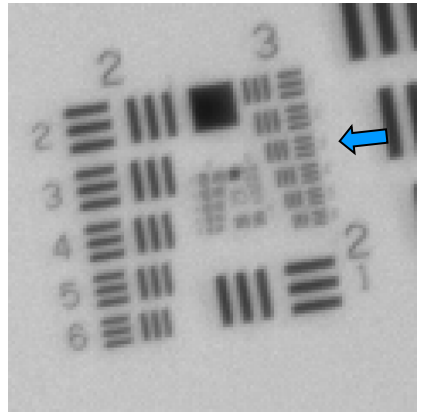

| | Center | Edge | Corner |
|---|---|---|---|
| USAF element: | 4/5 | 4/5 | 4/5 |
| Line width (um): | 19.69 | 19.69 | 19.69 |
| Lp/mm (object): | 25 | 25 | 25 |
| Magnification: | 0.147 | 0.147 | 0.147 |
| **Lp/mm (image):** | **173** | **173** | **173** |



optotune

# Polychromatic performance: White LED vs. Blue LED
# WD 500mm, +1.31dpt

**Camera**
Sensor size = 4512 x 4512 px
Pixel size = 2.74 um
Nyquist limit = 182 lp/mm

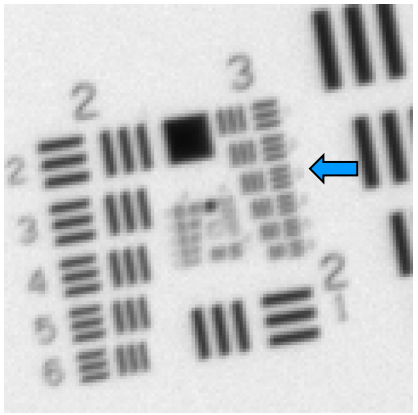
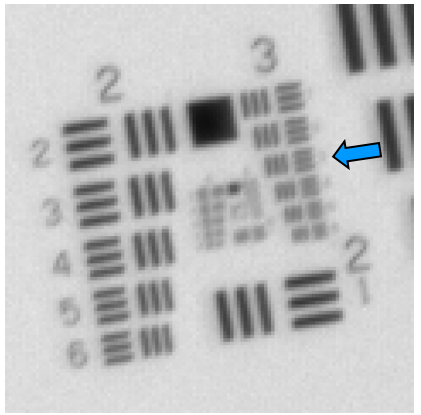
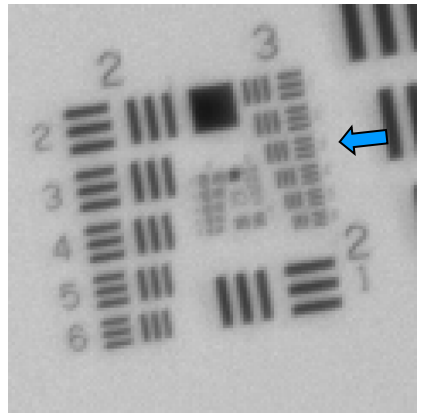
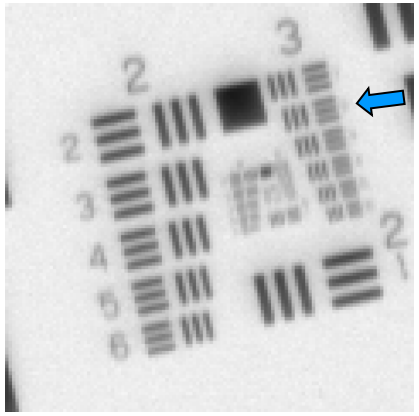
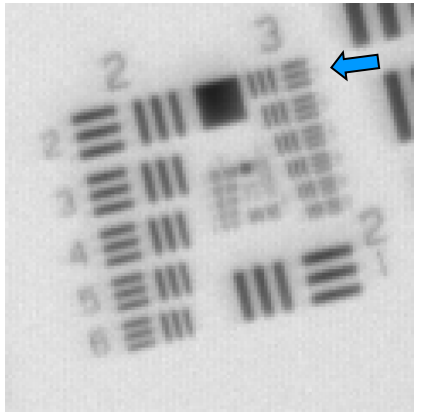
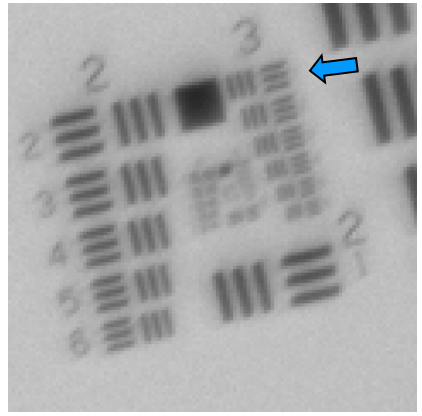
| | Center | Edge | Corner |
|---|---|---|---|
| Blue |  171 LP/mm |  152 LP/mm |  152 LP/mm |
| White |  152 LP/mm |  152 LP/mm |  152 LP/mm |

# Vertical vs. Horizontal optical axis
# WD 500mm, +1.31dpt, White LED

**Camera**
Sensor size = 4512 x 4512 px
Pixel size = 2.74 um
Nyquist limit = 182 lp/mm

**Light**
White background illumination

**EL-12-30 Gravity coma: 0.18λ**

| | Center | Edge | Corner |
|---|---|---|---|
| Vertical OA |  152 LP/mm |  152 LP/mm |  152 LP/mm |
| Horizontal OA |  136 LP/mm |  121 LP/mm |  121 LP/mm |