

AR Waveguide Metrology

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Total Process Ownership for AR Optical Metrology

2

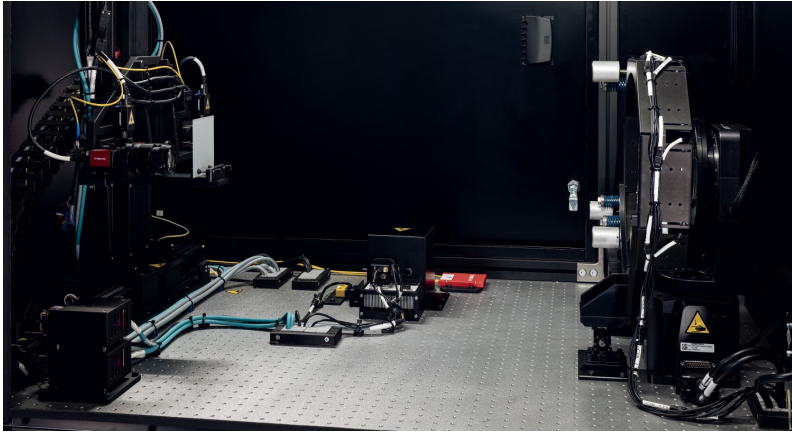
- ✓ 18 years of expertise in test automation, optical metrology
- ✓ Off-the-shelf products and tailored test solutions
- ✓ 14000+ delivered systems
- ✓ 450+ true tech geeks worldwide
- ✓ 18 support and service teams on 3 continents
- ✓ Working with all major brands including Google, Xreal, Intel, AMD, Qualcomm, Samsung, Lenovo, Asus, Dispelix, Pico, Sunny Optical
- ✓ HQ and own manufacturing in Finland, EU
- ✓ Engineering offices in Cupertino, CA and Redmond, WA
- ✓ Engineering and manufacturing facilities in APAC
- ✓ Global market leader in AR and Touch display optical metrology and robot-assisted test & measurement systems



Total Process Ownership for AR Optical Metrology

3

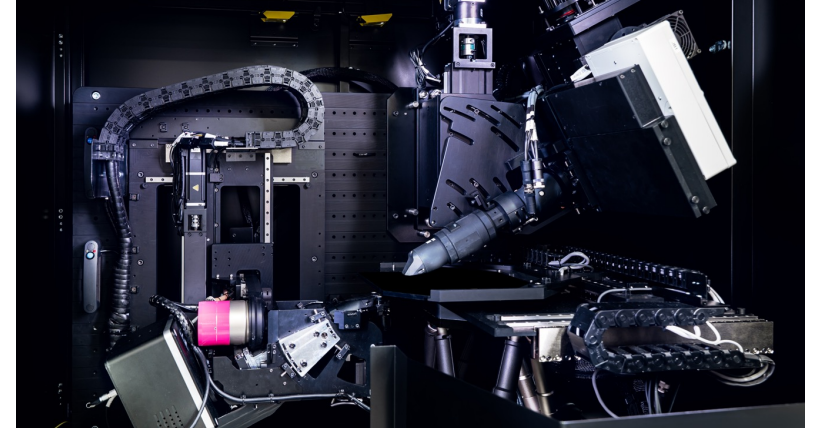
MASTER CREATION & ANALYSIS



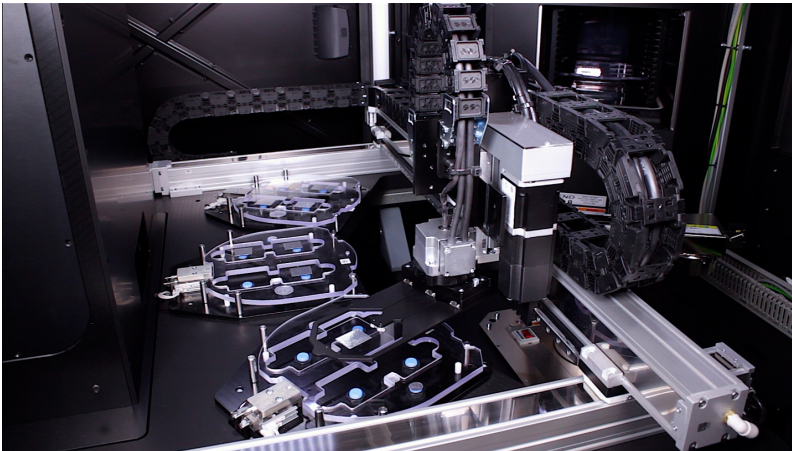
STACKING



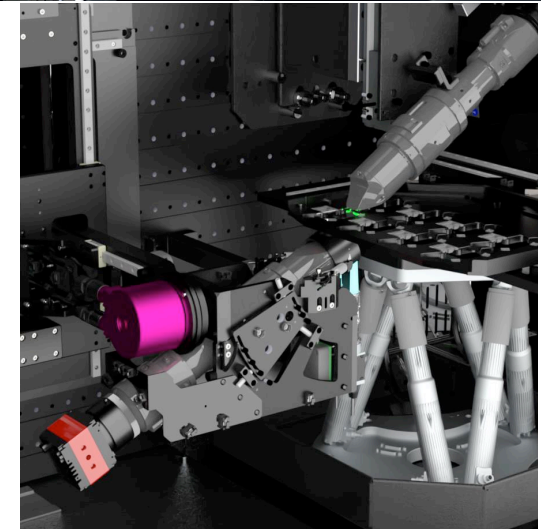
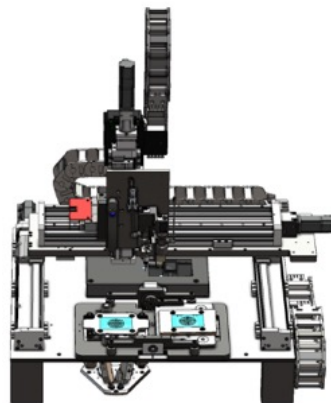
IMAGE QUALITY



REPLICATION & VISUAL INSPECTION



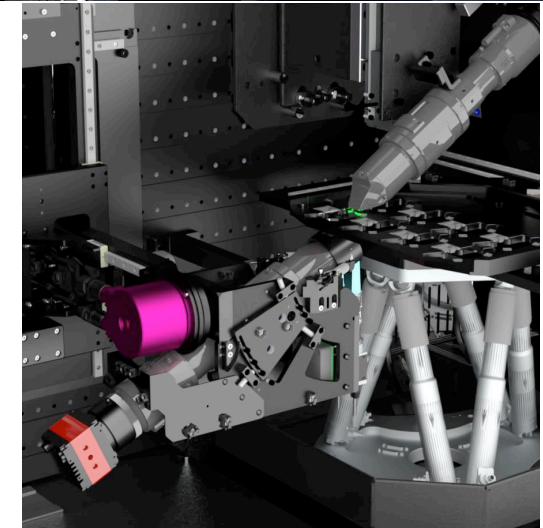
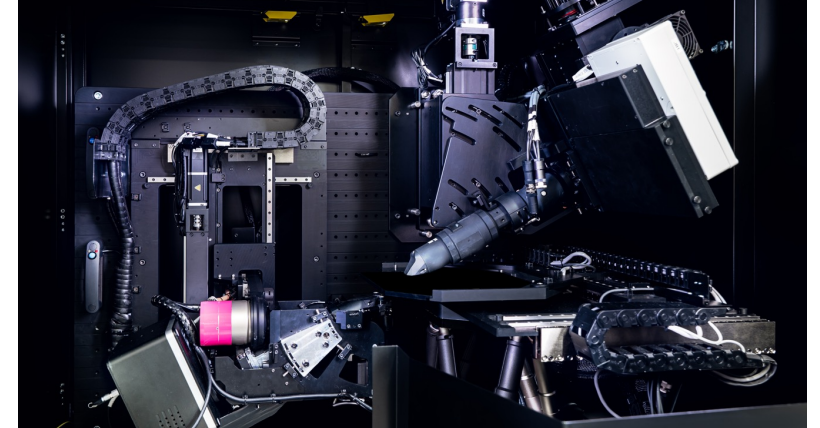
ACTIVE ALIGNMENT



Total Process Ownership for AR Optical Metrology

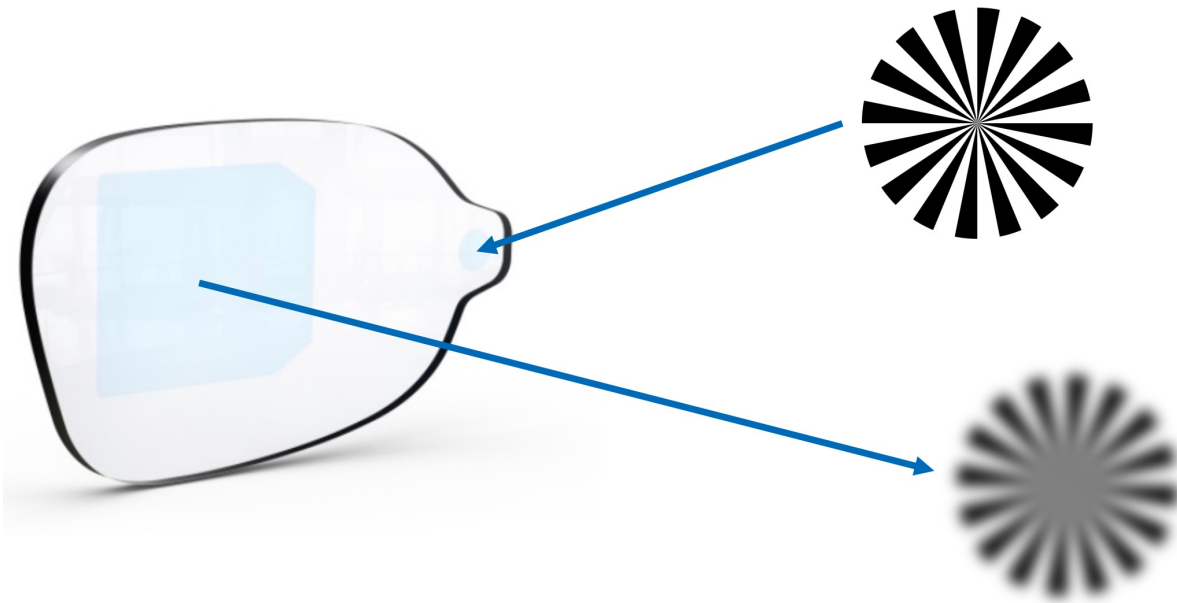
4

IMAGE QUALITY



What is the problem?

5



Expectation



Worst Case Reality

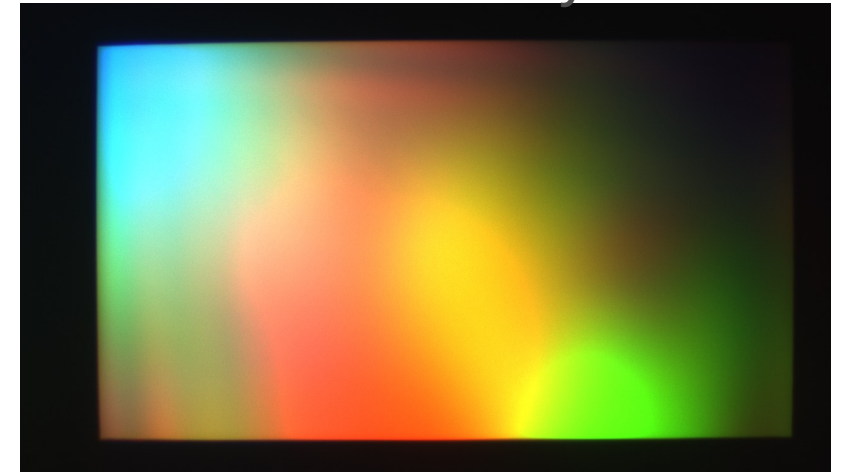


Image Quality Measurements for AR Waveguides

6

Human-eye mimicking optical setup

- **OptoEYE**, mimics the human eye's radiometric properties
- **OptoColor**, mimics the human eye's colorimetric properties
- **OptoProjector**, mimics a uniform, powerful light engine

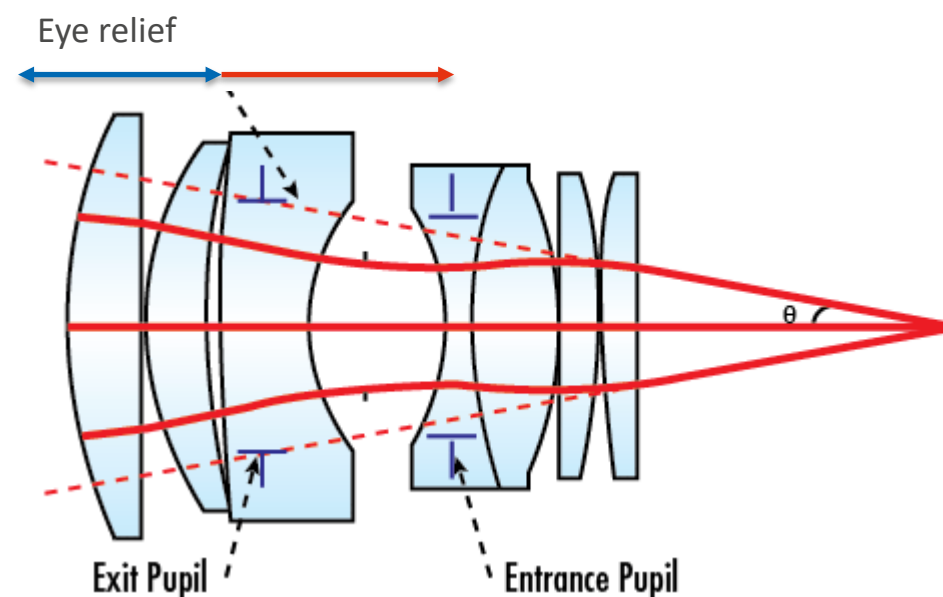
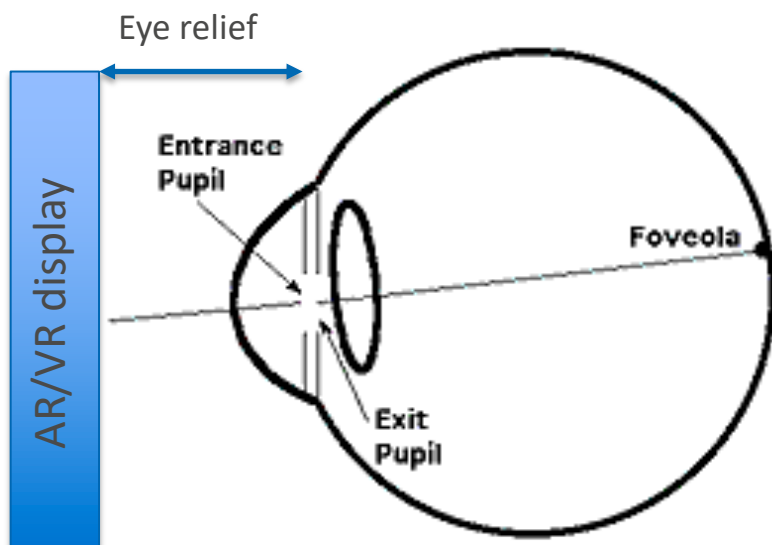
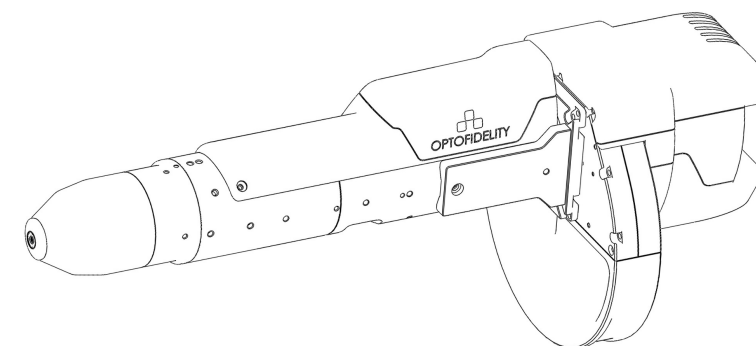


Image Quality Measurements for AR Waveguides

7

Robotics

- pantoscopic tilts (up to 12°)
- face wraps ($\pm 7.5^\circ$)
- Rx up to ± 8 dpt
- both world-side and eye-side
- wafers and diced waveguides

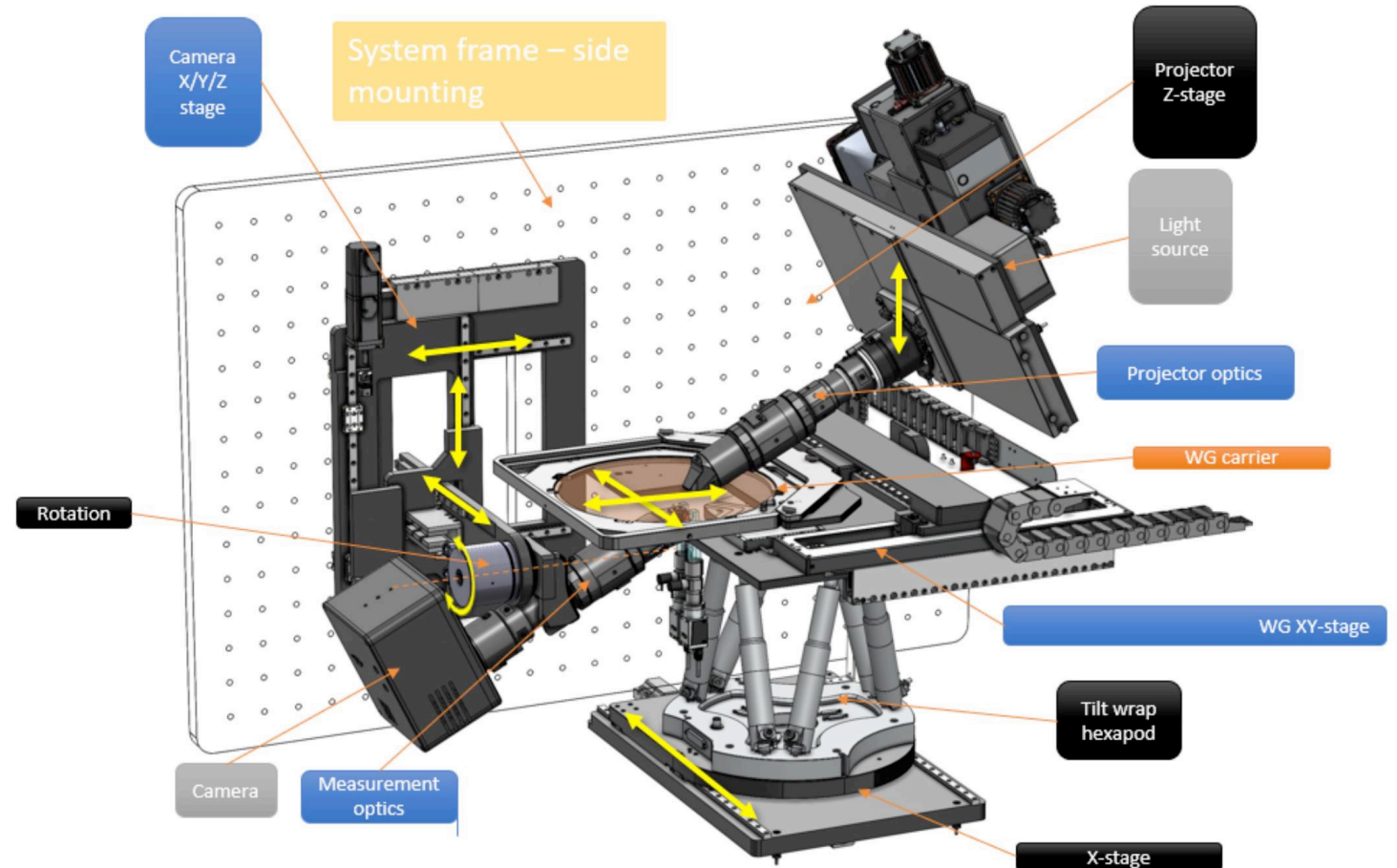
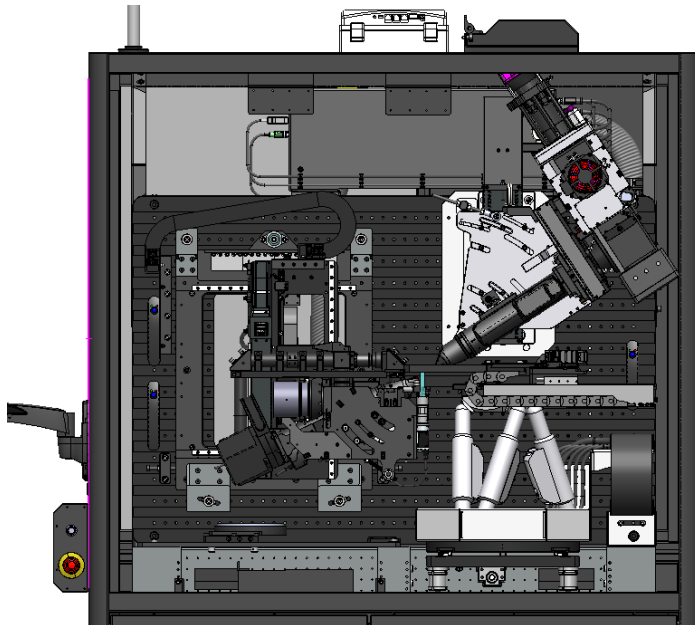


Image Quality Measurements for AR Waveguides

8

Measurements

Checkerboard contrast

Colour

Colour uniformity

CRA(Chief Ray Angle)

Efficiency

Eye box

FOV

Geometric distortion

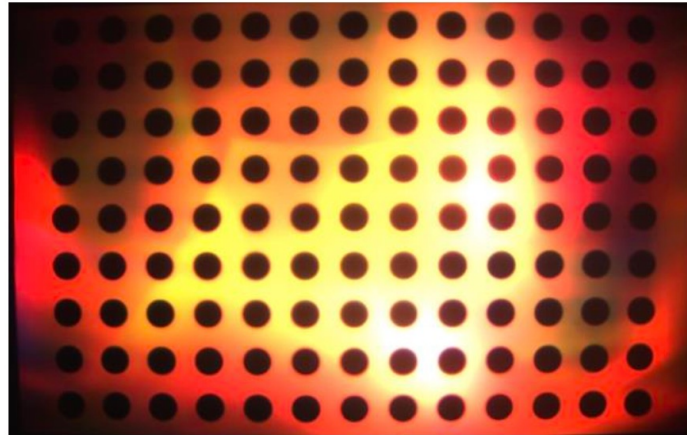
Luminance

Luminance uniformity

MTF

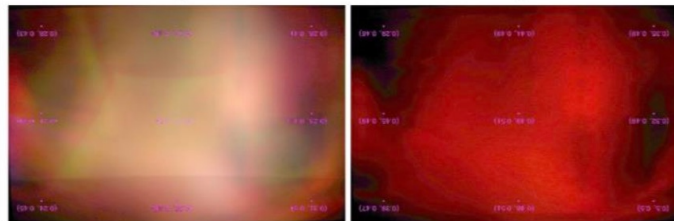
Pointing vector

Transverse chromatic aberration



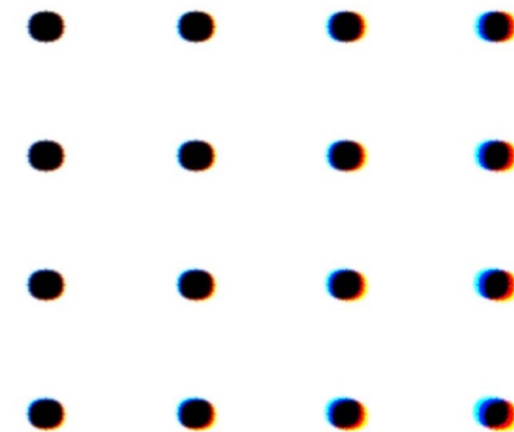
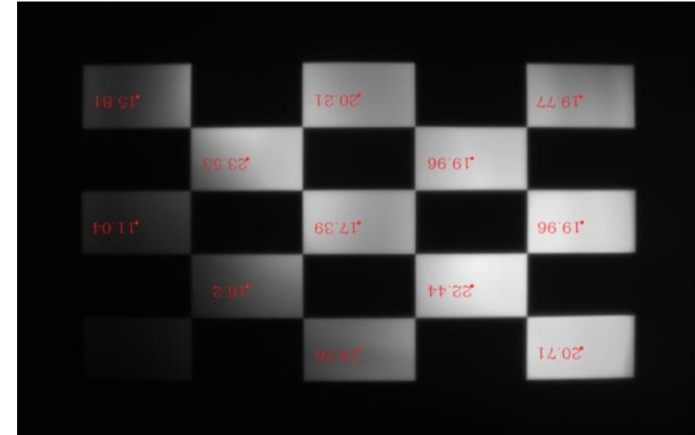
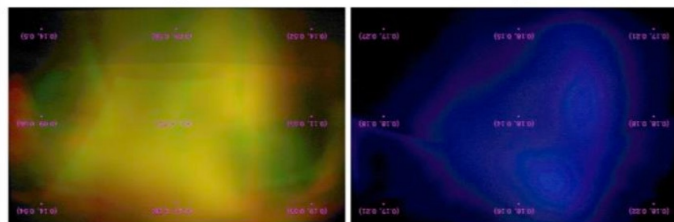
(p)

(c)



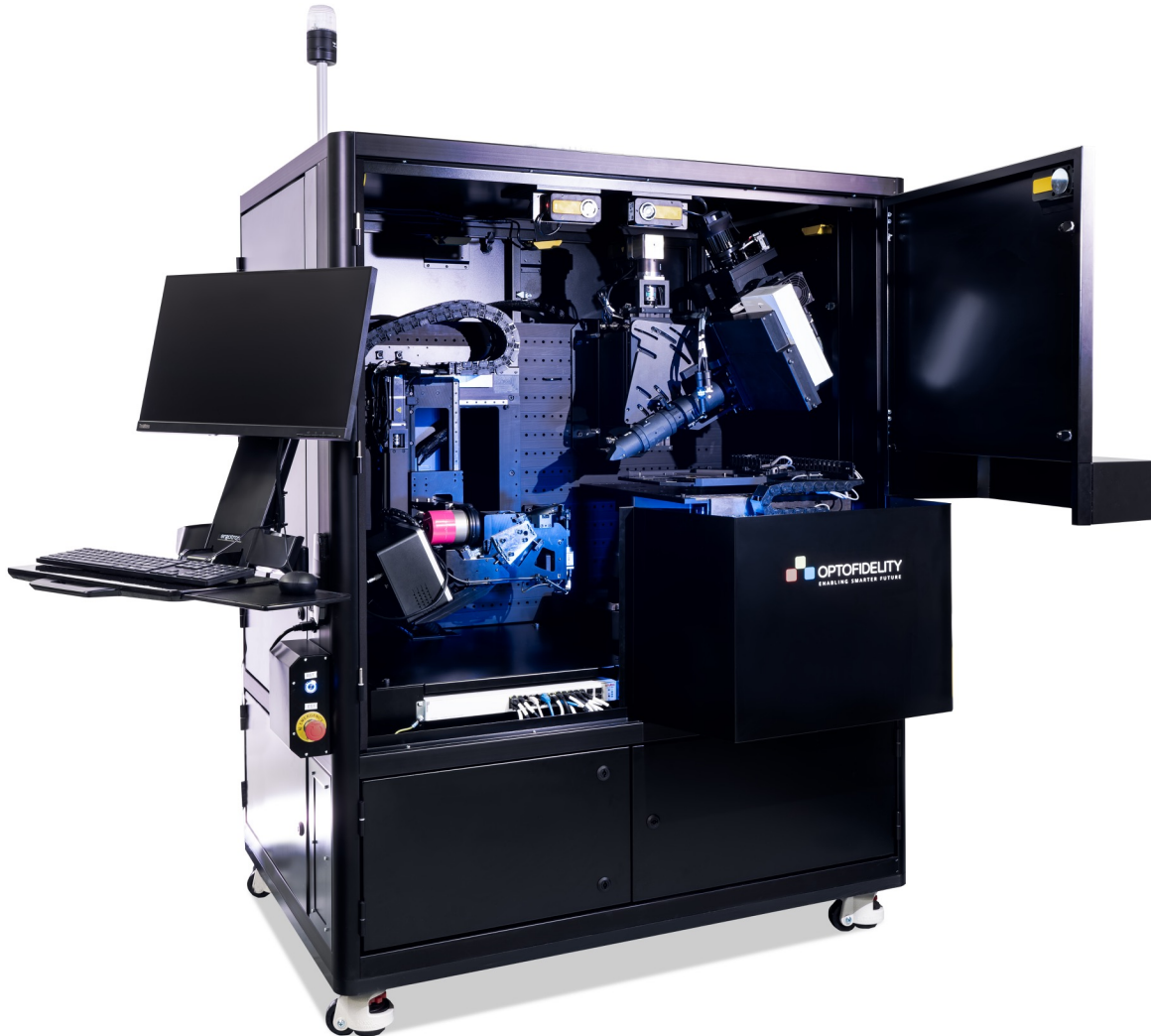
(b)

(a)



WG-IQ: Waveguide Image Quality Measurement System

9



<https://youtu.be/LyQj0UnVDYE>



Thank you!

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