Addressing Near-Infrared Sensing Challenges Through LED and Laser Measurement

Presented by: Gavin Wilson Smillie

September 8, 2026

Today’s Presenter

Gavin Wilson-Smillie

Business Development Manager

Gavin Wilson-Smillie is a sales and business development professional at Konica Minolta Sensing Americas (KMSA), where he helps customers identify advanced optical measurement solutions for automotive, aerospace, AR/VR, medical, defense, consumer display, and emerging technology applications. He works closely with engineers, researchers, and manufacturers to understand their testing requirements and connect them with technologies from Konica Minolta Sensing, Instrument Systems, and the Radiant Vision Systems portfolios.

Joining KMSA in April, he brings past industry experience in similar markets and related applications. Gavin is excited to help KMSA’s current and future clients get the best out of their measurement equipment, with the goal of achieving project success whether R&D or mass production.

KONICA MINOLTA

RETHINK WHAT‘S POSSIBLE

Today's Agenda

- Sensing with Light
- Near-IR Light Sources
- Performance Considerations
- Measuring Near-IR Sources
- Q&A

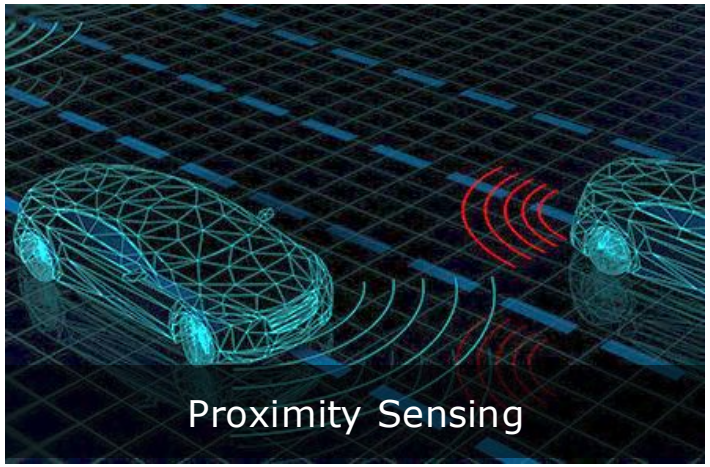
KONICA MINOLTA

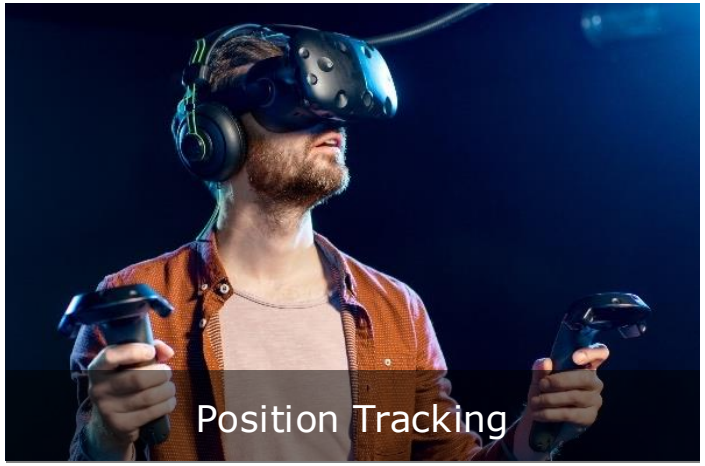
SENSING WITH LIGHT

Background & Applications in Consumer Electronics, AR/VR, and Beyond

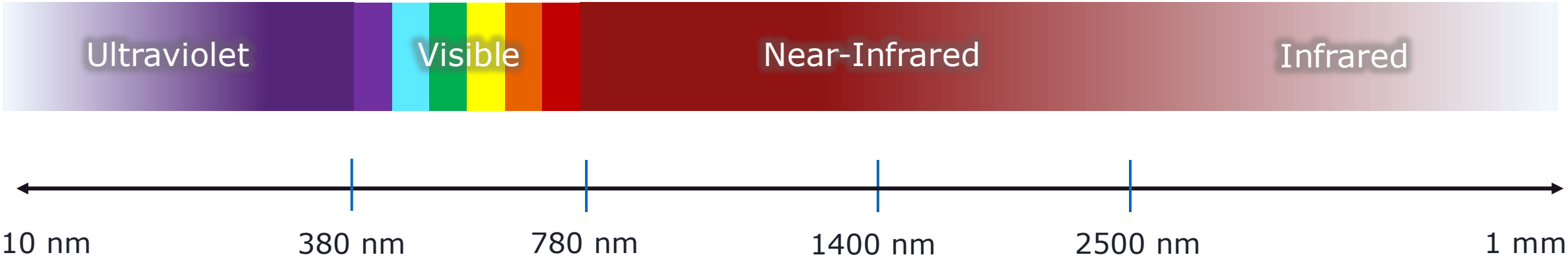
SENSING WITH LIGHT

KONICA MINOLTA





Near-Infrared (NIR) Light



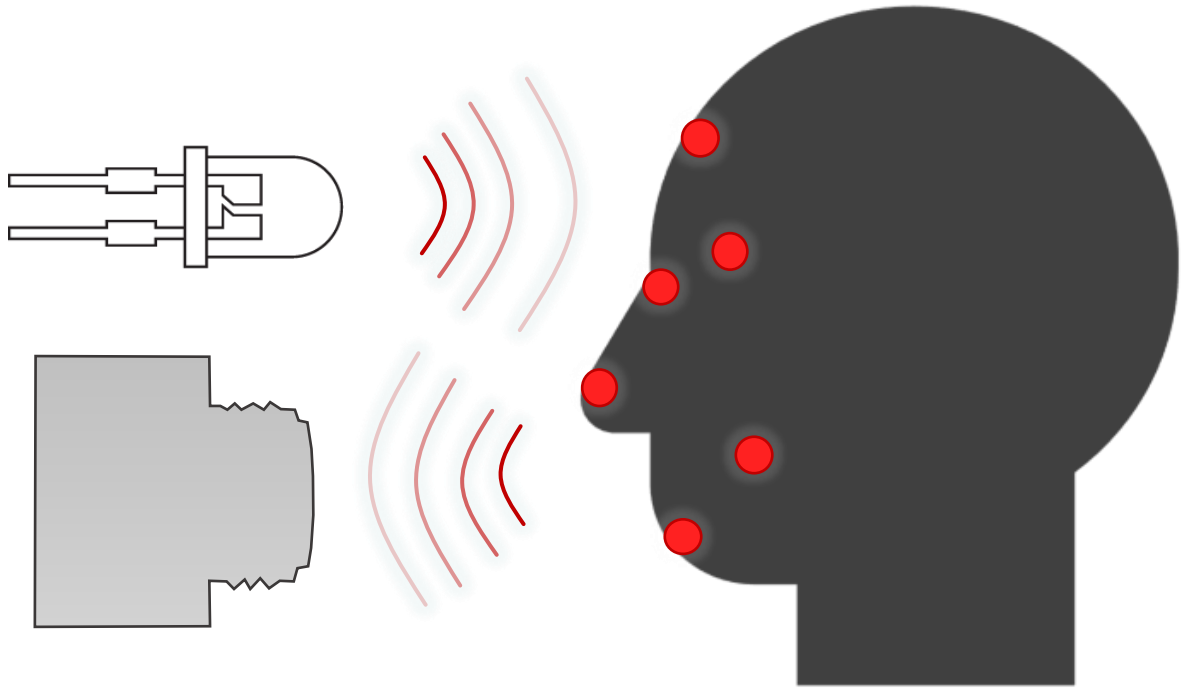
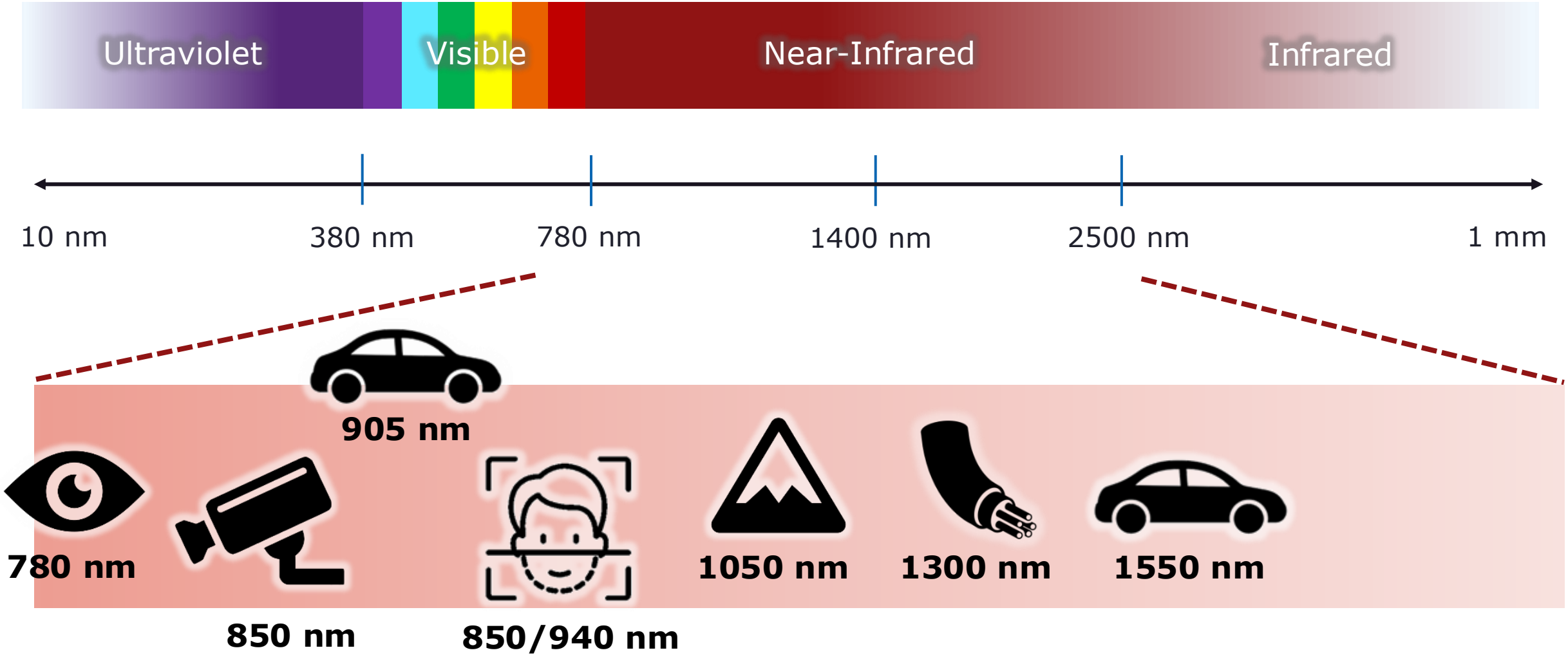


Image Source: [My Laser Spectrum Blog]

Applications by Wavelength



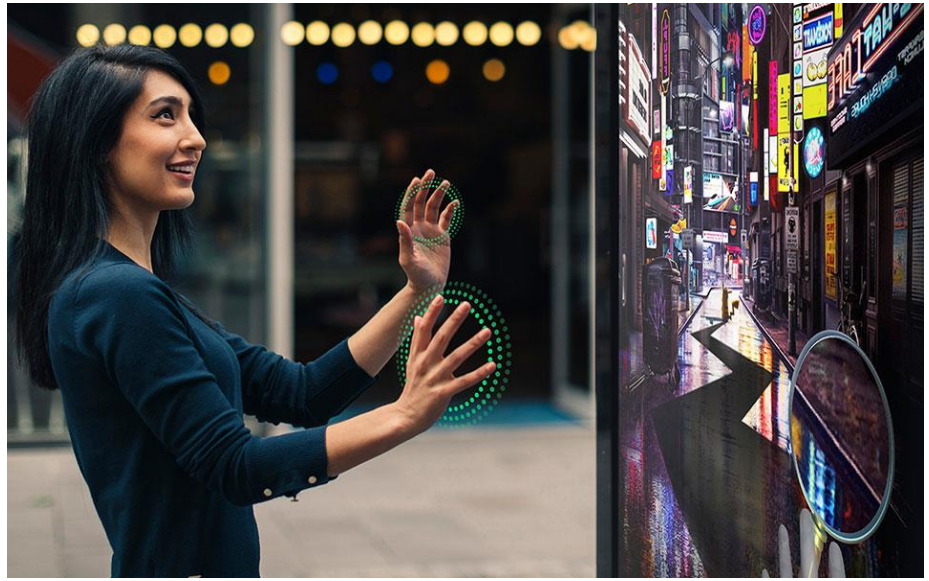
TRENDS: CONSUMER ELECTRONICS

KONICA MINOLTA

IDENTIFICATION

Sensing facial features enables device authentication and personalization.

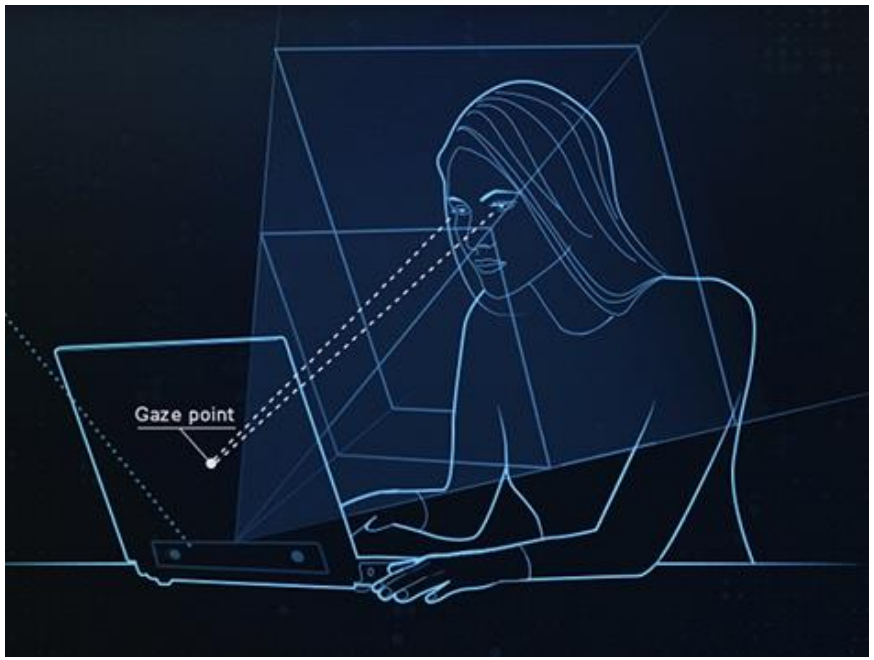
GESTURE RECOGNITION



Near-IR sensors track gestures that enable touch-free device interfaces.

TRENDS: CONSUMER ELECTRONICS

EYE TRACKING



Eye tracking enables interface controls to scroll and select PC applications.
Source: Tobii

Eye tracking enables Tobii Ghost, an on-screen virtual indicator of the gamer's gaze.
Source: Tobii

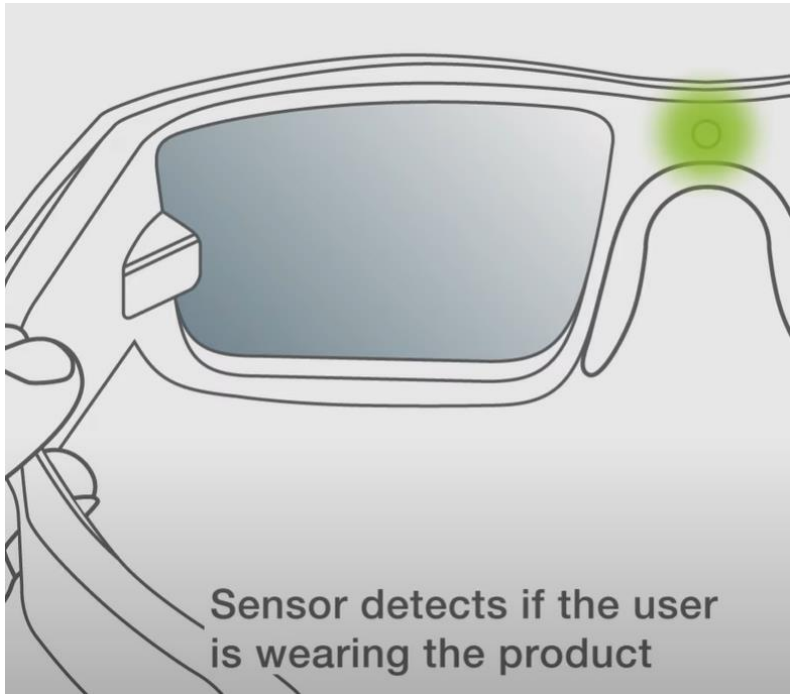
TRENDS: AUGMENTED & VIRTUAL REALITY

KONICA MINOLTA

FACIAL RECOGNITION

Facial tracking enables rendering of virtual avatars, as introduced by the VIVE Facial Tracker.
Source: HTC

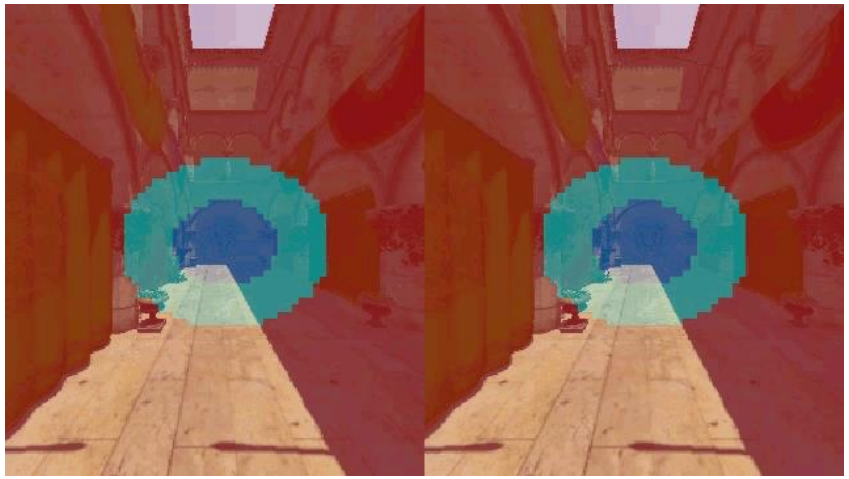
USER DETECTION

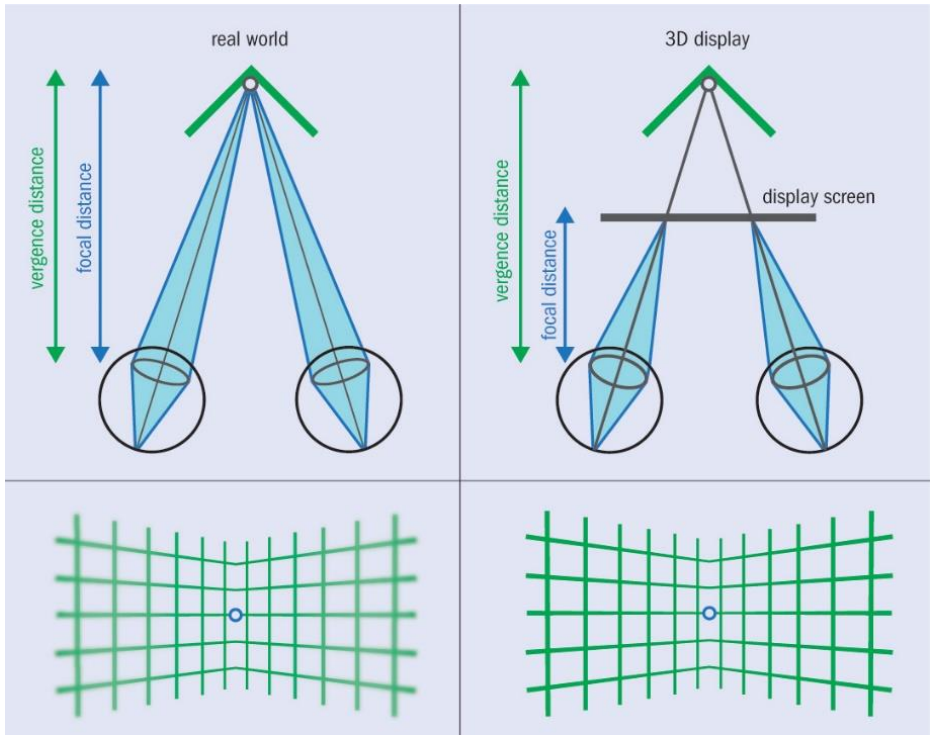


Near-IR proximity sensor detects if the user has put on a headset.
Source: OSRAM

TRENDS: EYE TRACKING IN AR

FOVEATED RENDERING



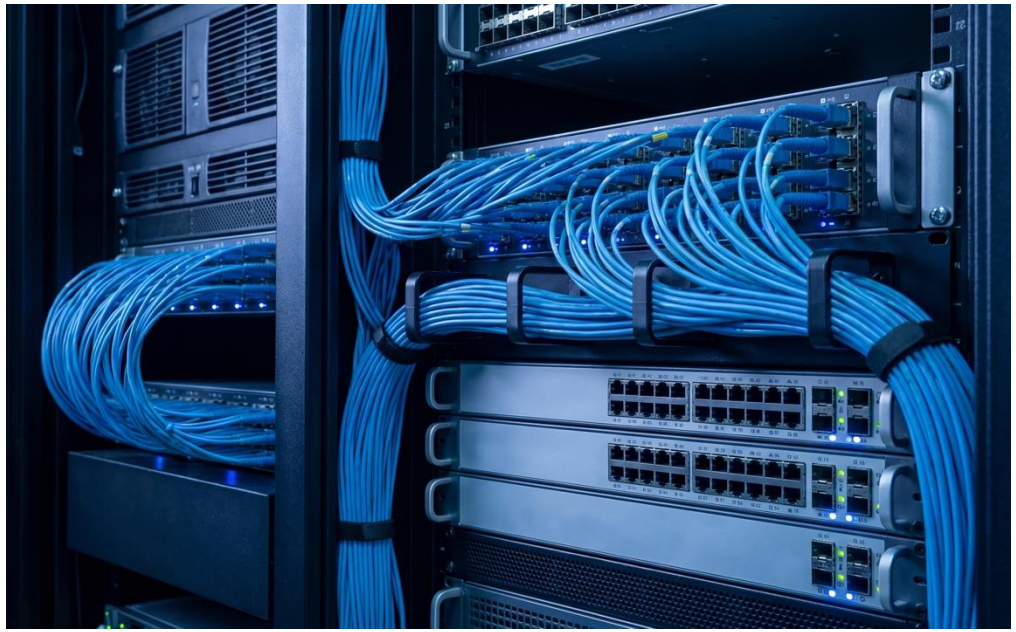


VR eye tracking enables NVIDIA's "Variable Rate Shading" in virtual images. Number of pixels processed in shading operations adapts to the area of focus (blue circles).

TRENDS: DATA INTERCONNECT

Vertical-Cavity Surface-Emitting Lasers (VCSELs)

VCSELs (Vertical-Cavity Surface-Emitting Lasers) are widely used in short-reach optical interconnects within AI data centers, particularly for high-speed links between servers, switches, and accelerator clusters. Their low power consumption, high modulation speeds, small footprint, and ability to be manufactured in dense arrays make them well suited for the massive parallel bandwidth requirements of AI infrastructure.

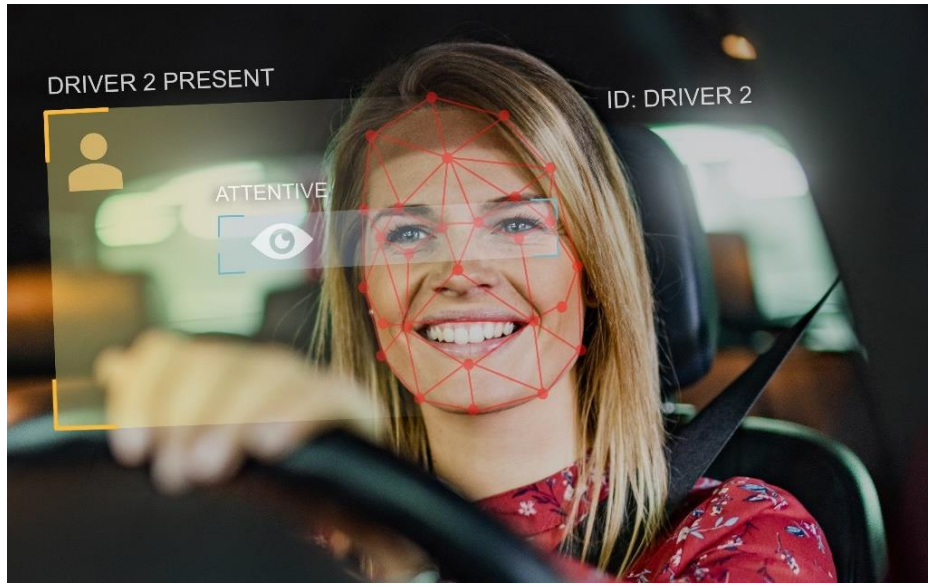


VCSELs are most commonly paired with multimode fiber for connections ranging from a few meters to several hundred meters, where they can provide a cost-effective alternative to longer-reach single-mode optical technologies. As AI systems continue to scale, higher-speed VCSEL arrays and advanced optical packaging are helping support increasing lane rates, lower energy-per-bit, and greater interconnect density.

TRENDS: AUTOMOTIVE

KONICA MINOLTA

DRIVER MONITORING



Driver monitoring systems may rely on near-IR light for driver ID, presence, position, and eye tracking.

HEAD UP DISPLAYS

Eye tracking used to optimize AR head-up displays to keep images in sight.
Source: Panasonic

TRENDS: HEALTHCARE

GESTURE RECOGNITION

Near-IR sensing for gestures enable sanitary, touchless interfacing for medical environments.
Source: GestSure

KONICA MINOLTA

NEAR-INFRARED LIGHT SOURCES

- ***Benefits and Applications of LEDs and Lasers***

NIR LIGHT SOURCES

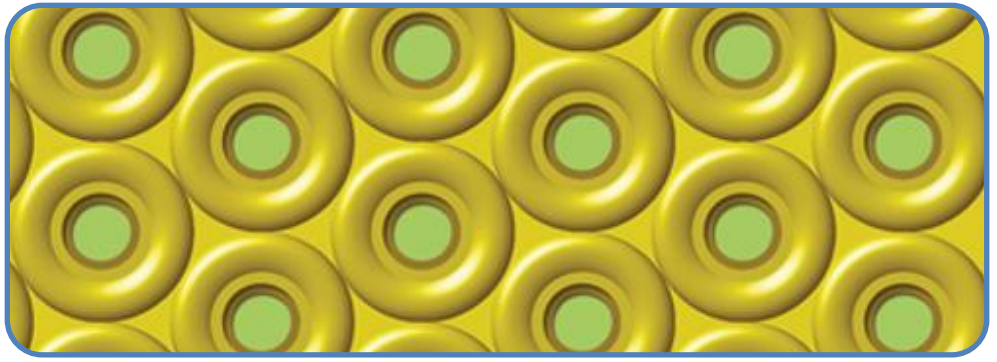
KONICA MINOLTA

LIGHT-EMITTING DIODES

LEDs (or IREDs)

Typically used for:
- Short-range sensing
- Time of Flight (TOF)
- Illumination for 2D cameras

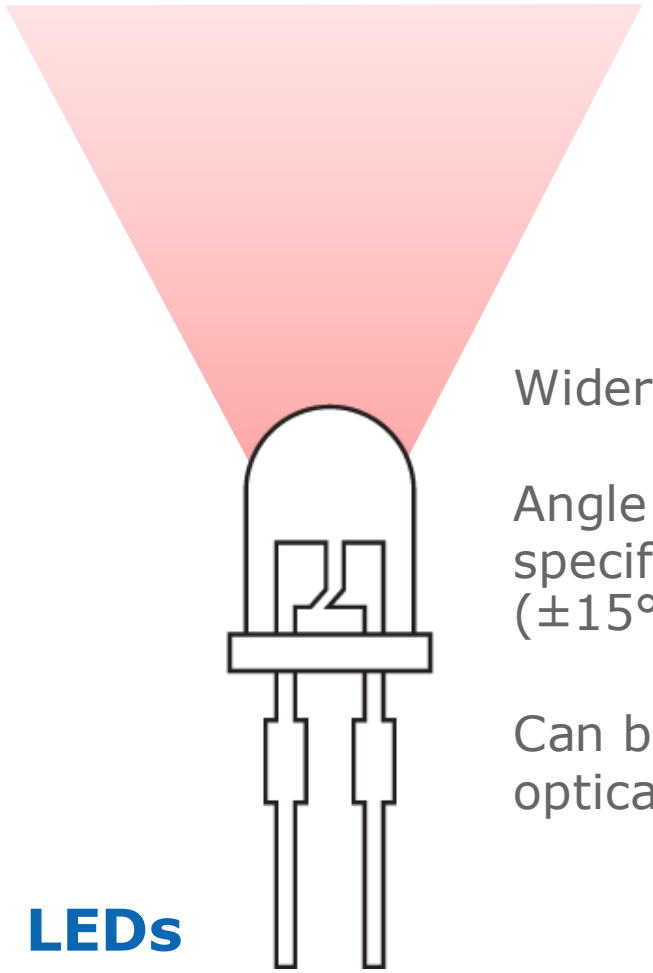
VERTICAL-CAVITY SURFACE-EMITTING LASER ARRAY



Lasers (VCSELs)

Typically used for:
- Long-range sensing
- Time of Flight (TOF)
- Pattern-based identification

Beam Angle

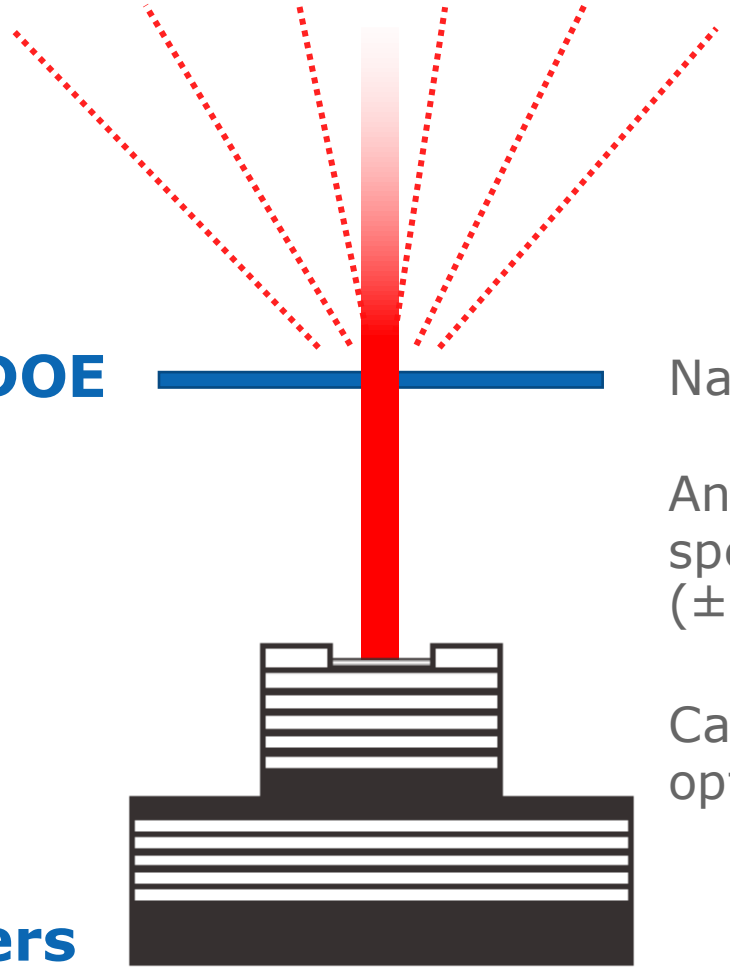


LEDs

Wider beam angle

Angle defined in source specifications (±15°, ±25°, etc.)

Can be narrowed using optical elements



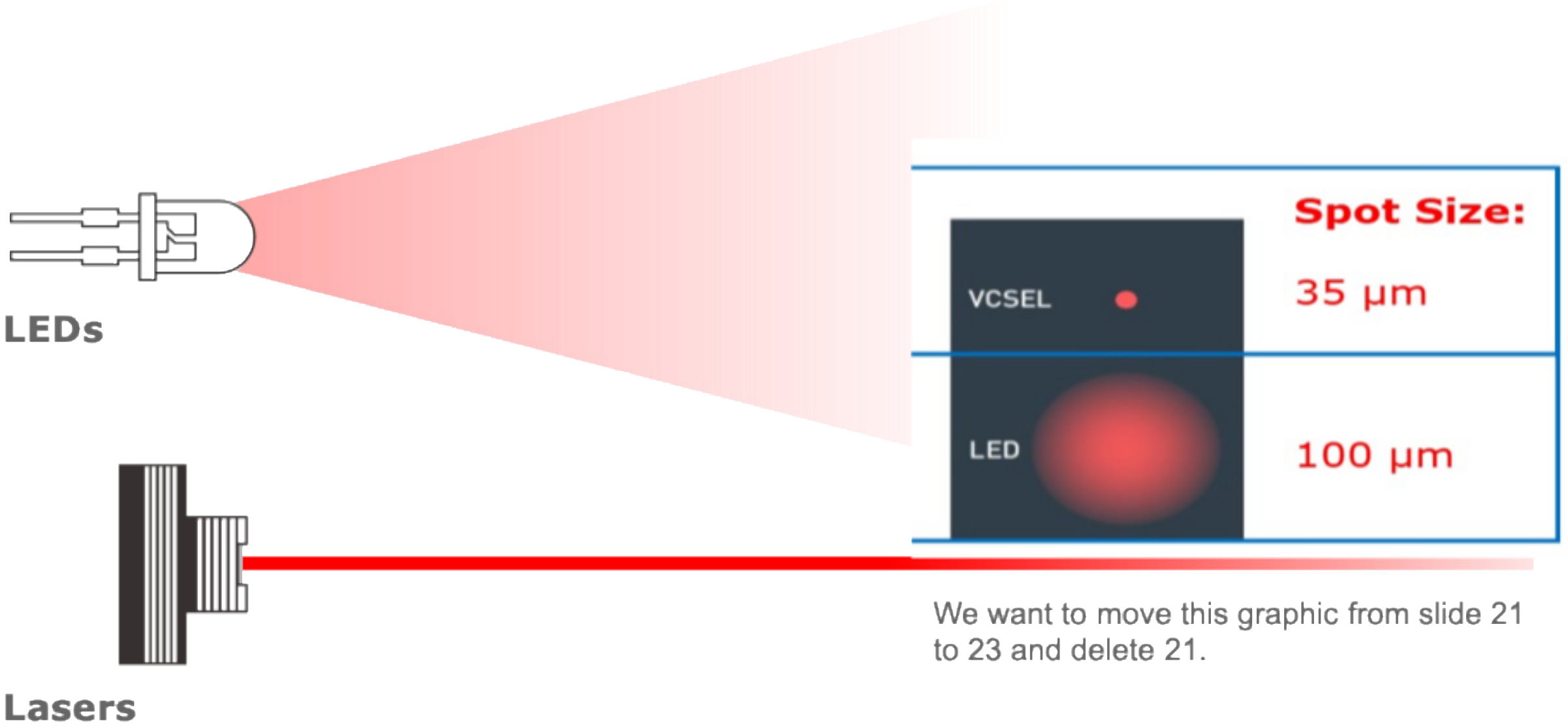
Lasers

Narrower beam angle

Angle defined in source specifications (±6°, ±15°, etc.)

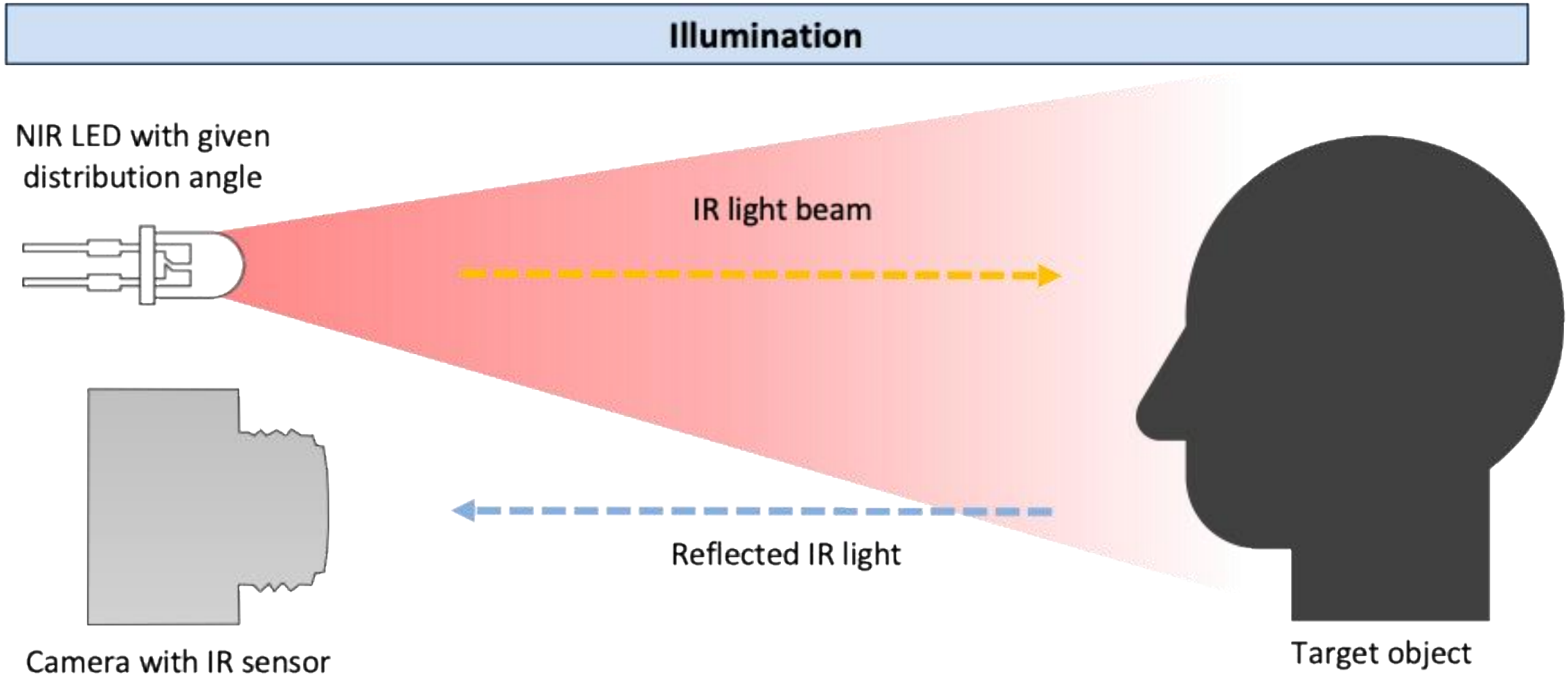
Can be diffracted using optical elements

Range

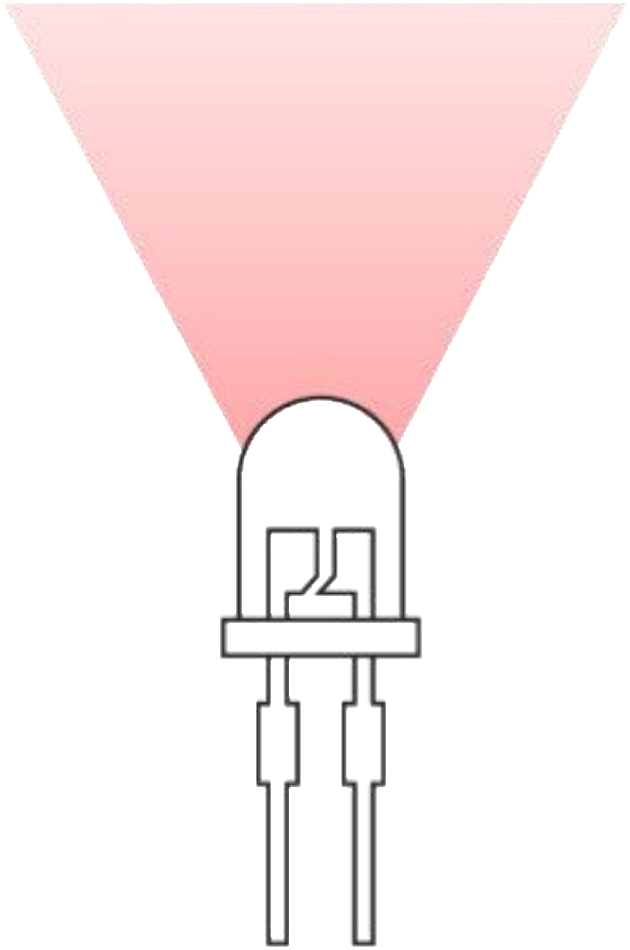


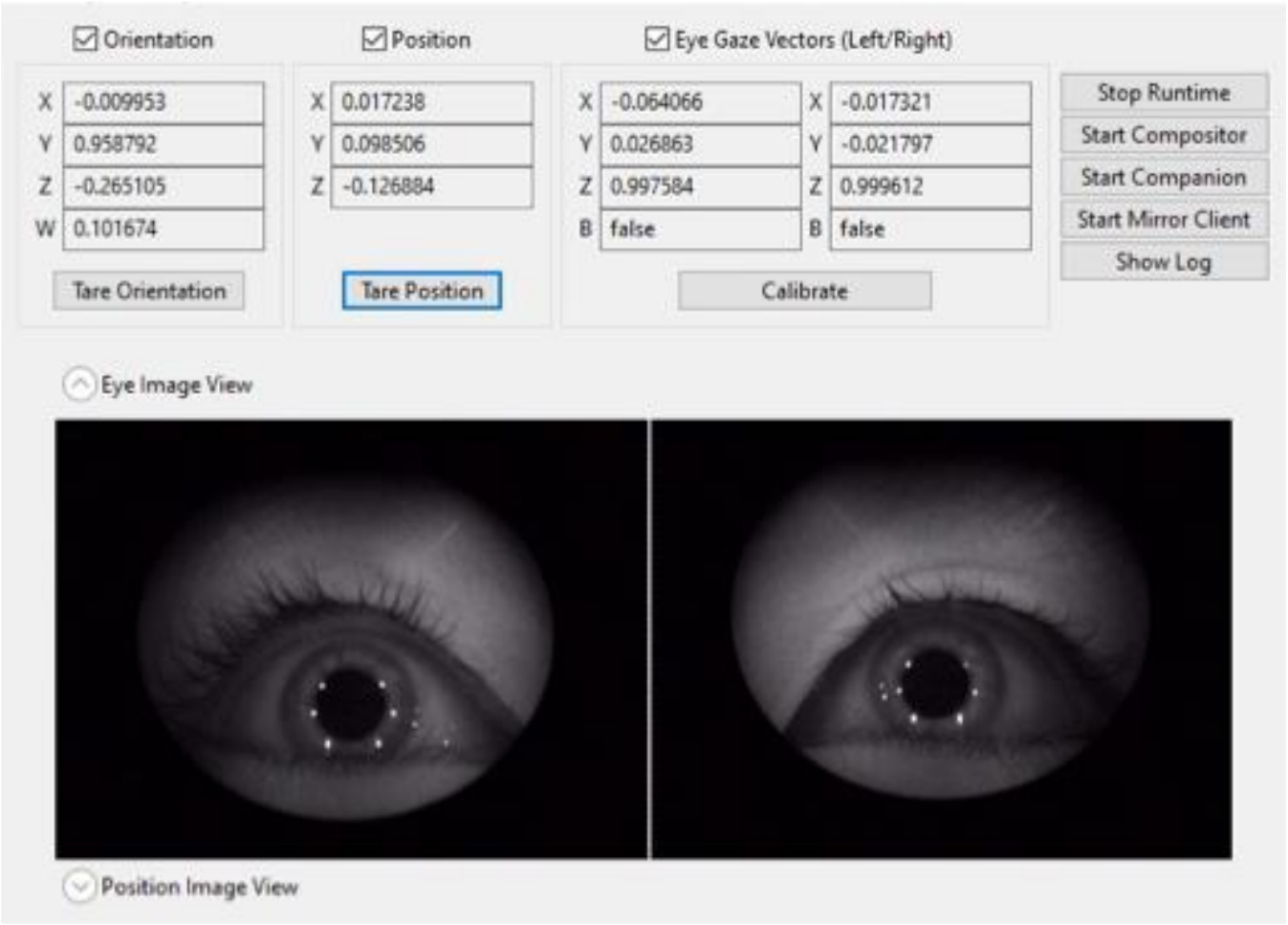
We want to move this graphic from slide 21 to 23 and delete 21.

Applications: 2D imaging (LED)



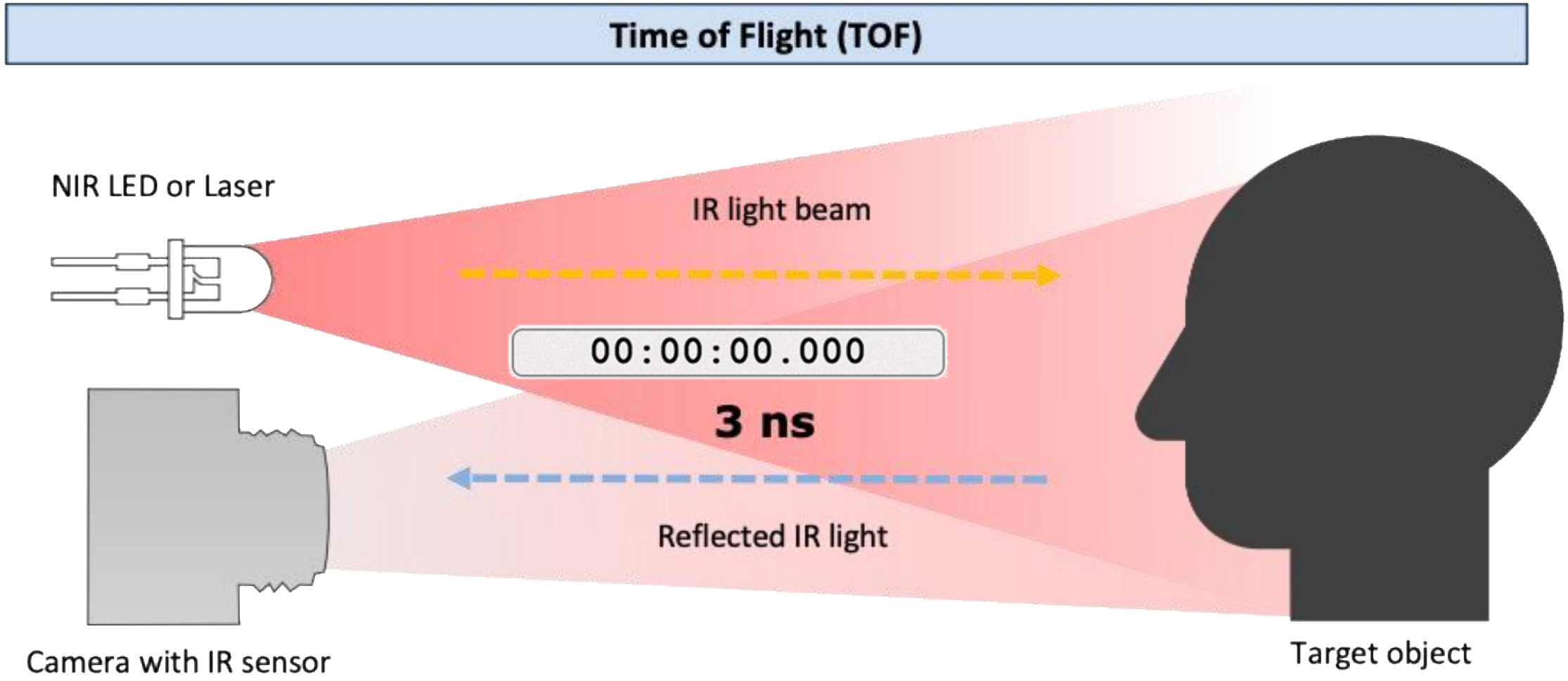
Example: LED Illumination





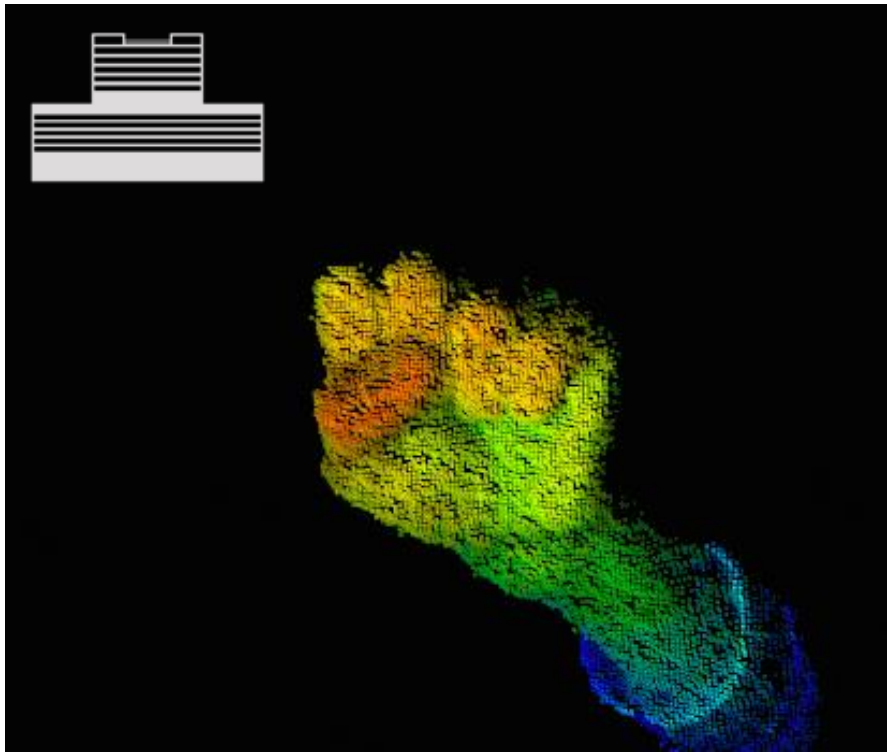
NIR LED illumination for eye tracking in an AR/VR headset. Source: FOVE

Applications: 3D Sensing (LED/Laser)



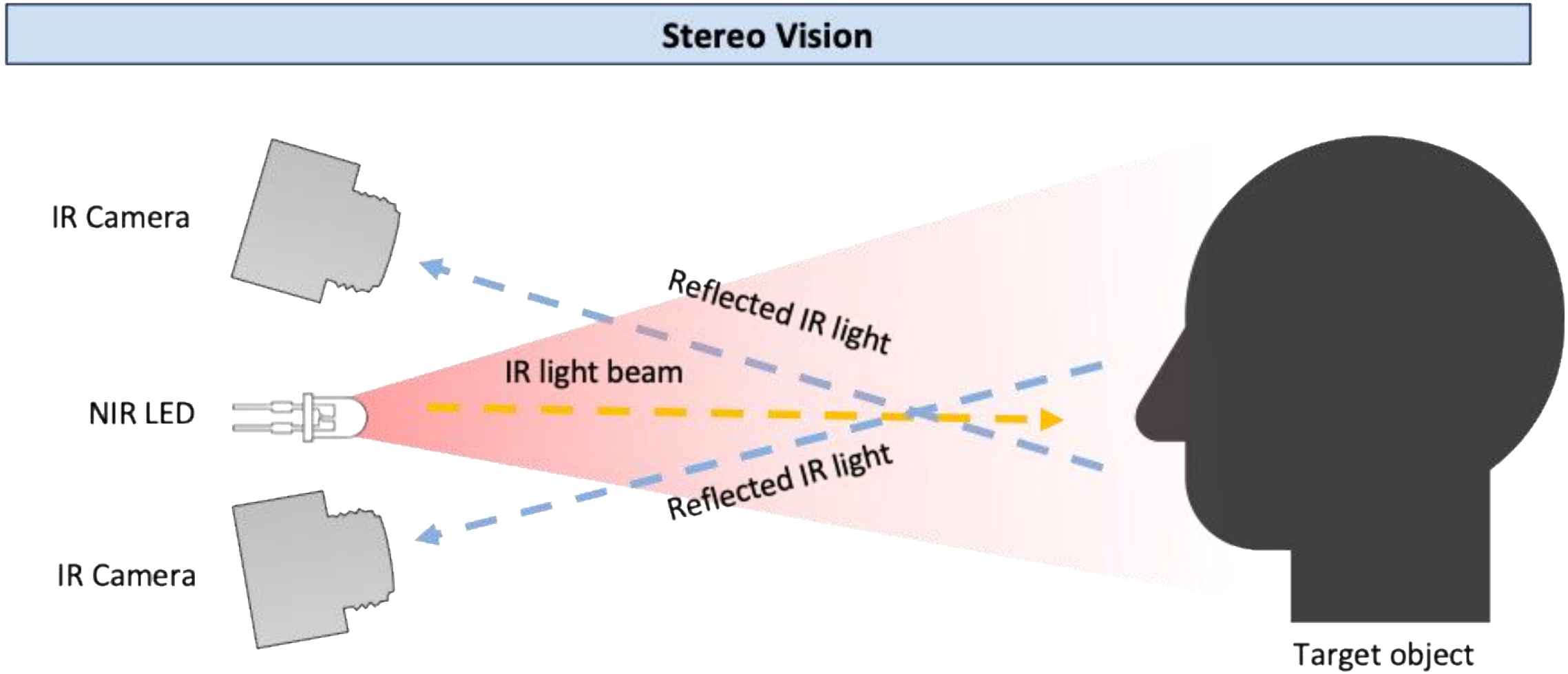
EXAMPLE: TIME OF FLIGHT (TOF)

An illustration of a TOF application, using NIR LED light to flood the user's face for facial recognition. Source: TechTheLead

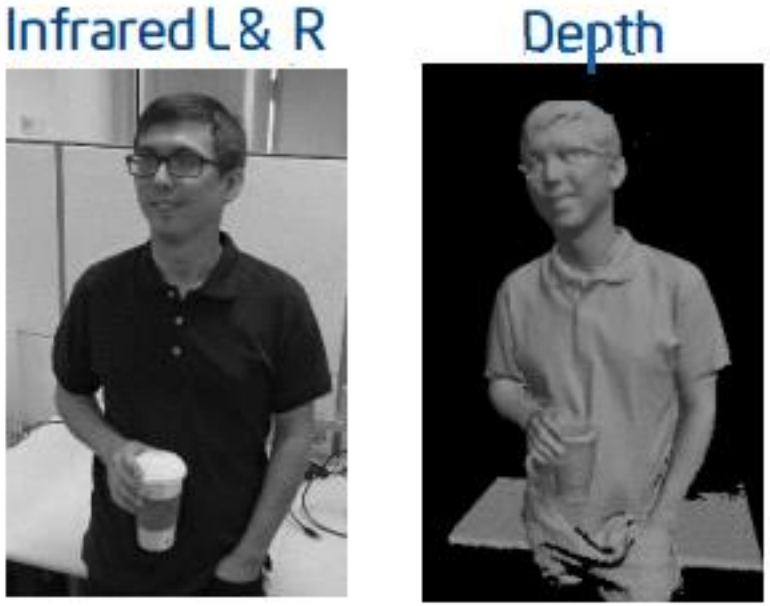


3D information gathered by NIR laser-based TOF sensing. Source: PMD

Applications: 3D Sensing (LED/Laser)

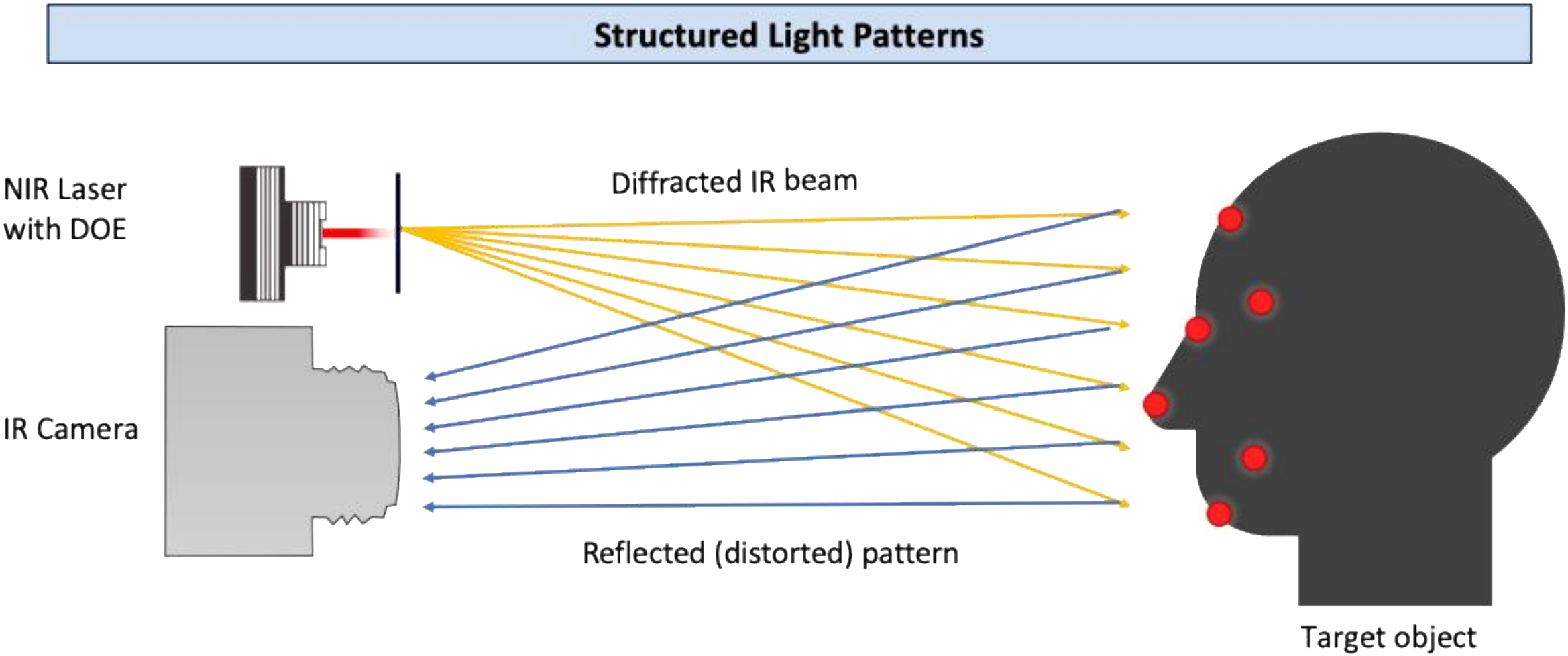


Example: Stereo Vision

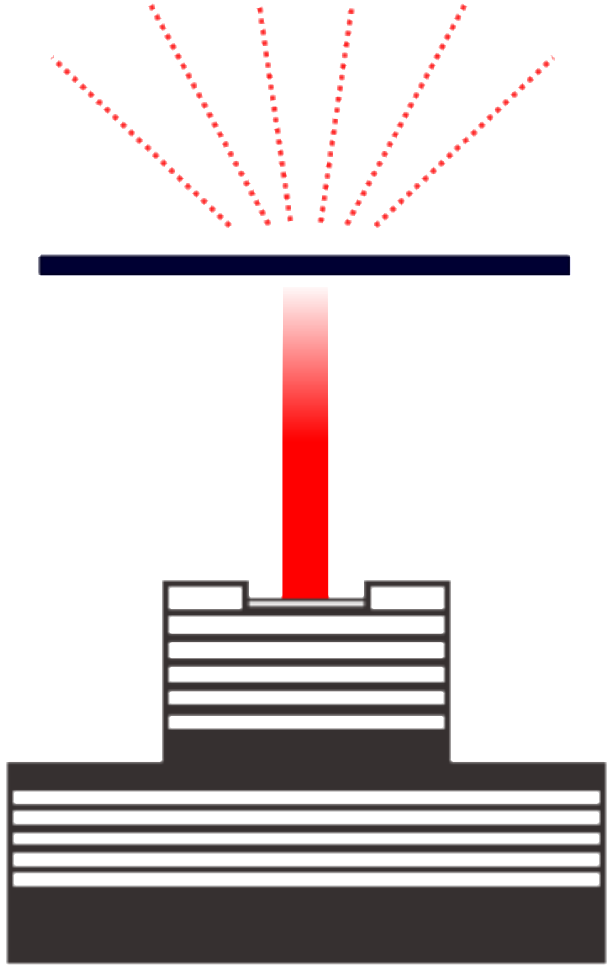


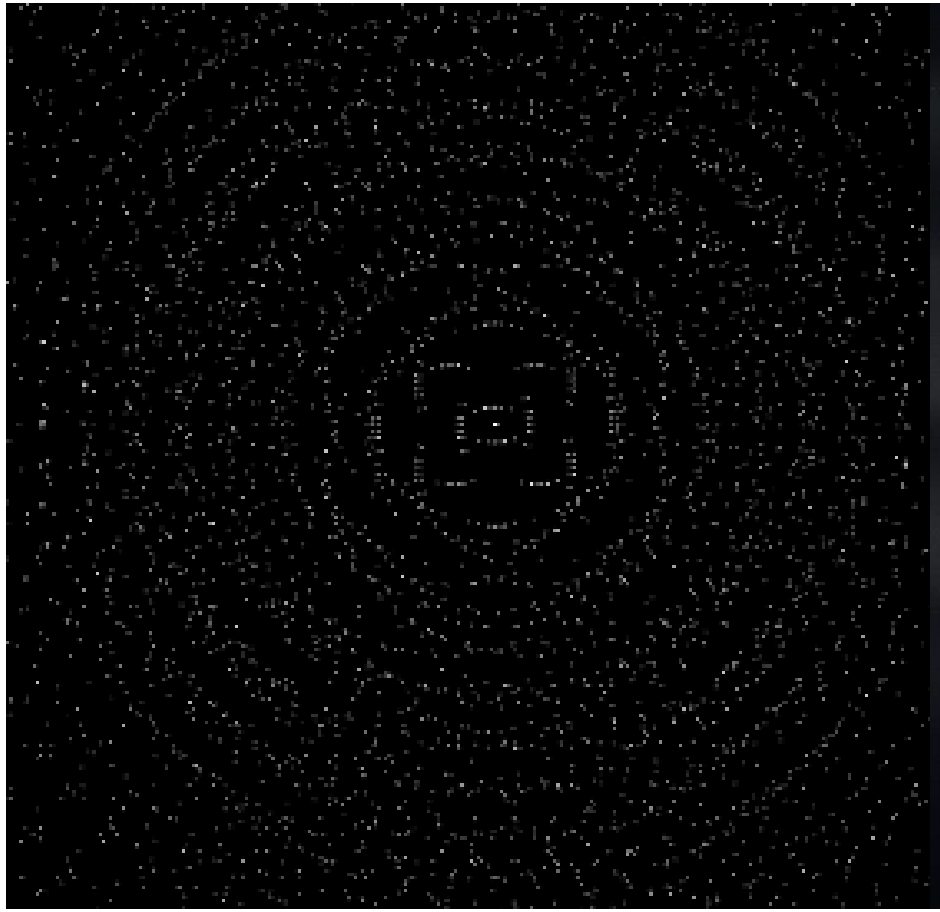
Intel® RealSense™ Depth Camera example. NIR laser light is captured by two IR cameras and combined to determine 3D object shape and depth information. Source: Intel

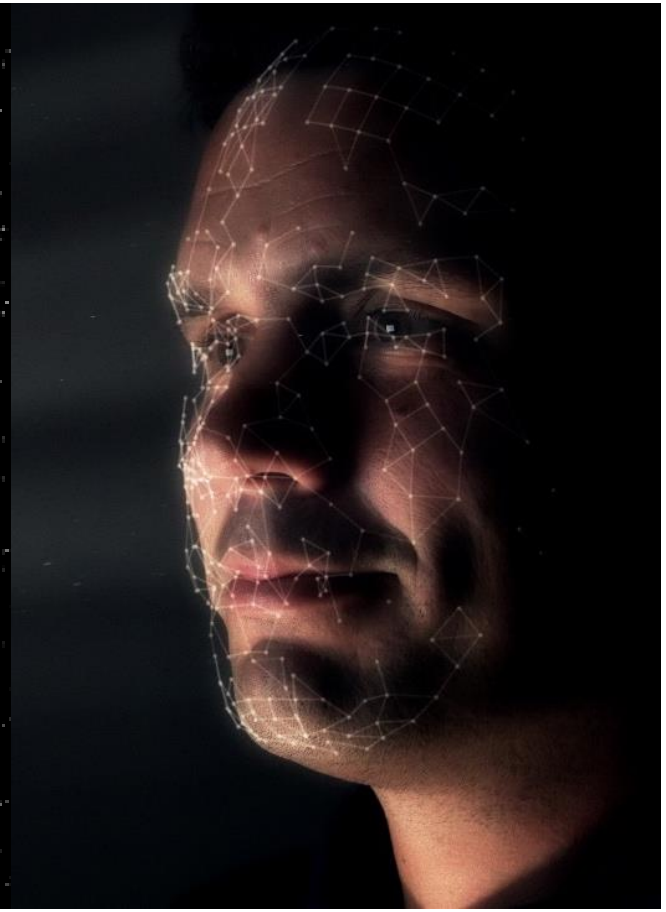
Applications: 3D Sensing (LASER)



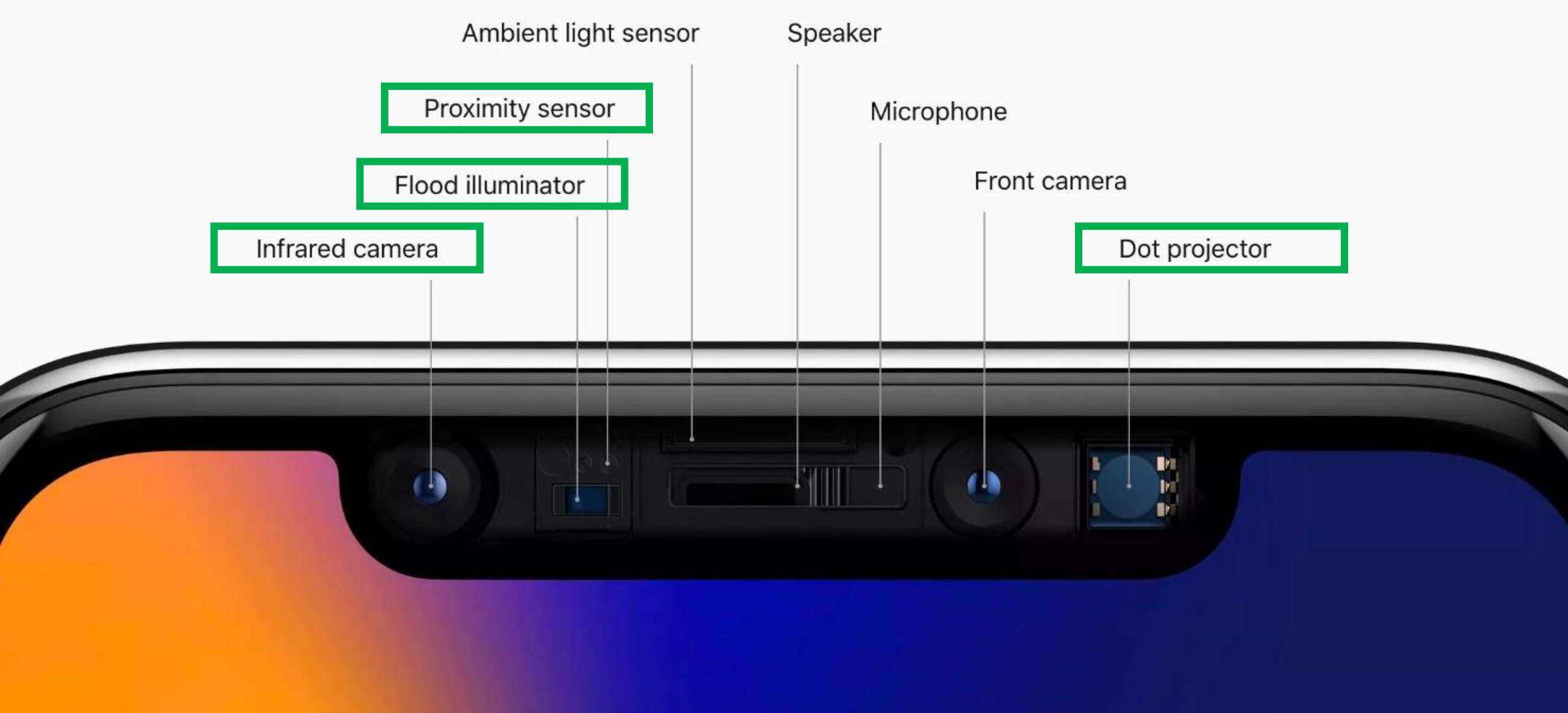
Example: Structured Light Patterns





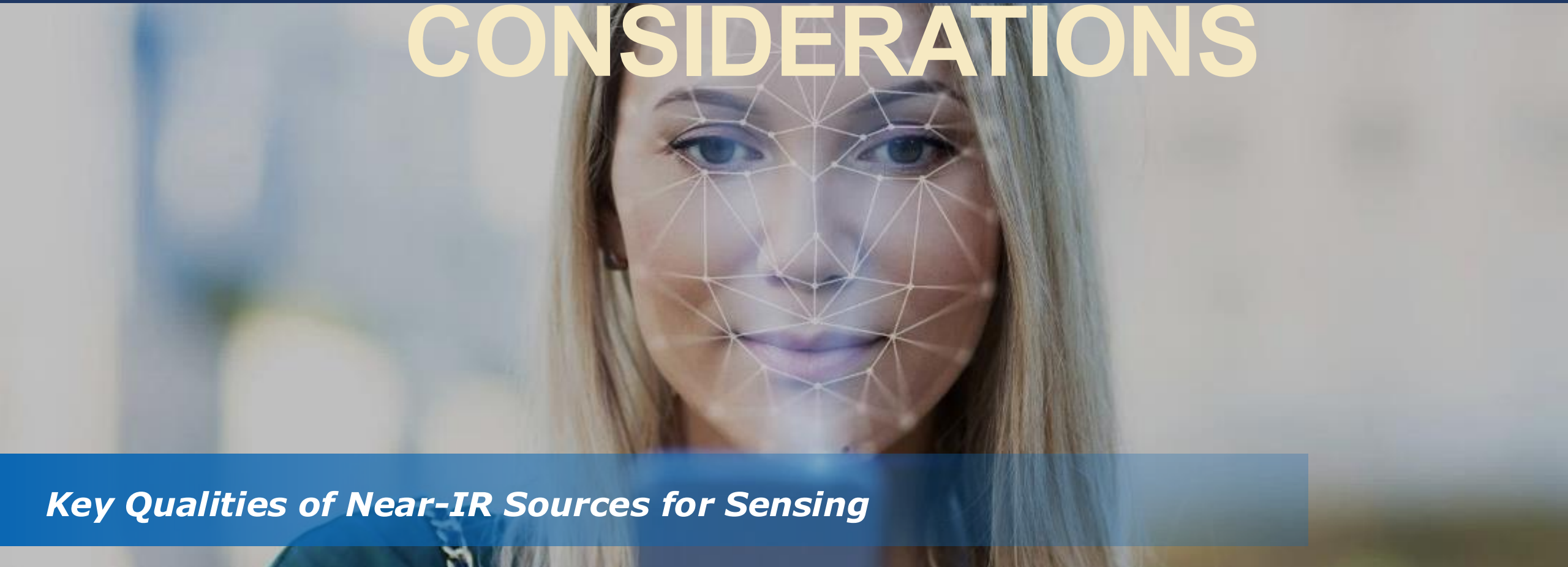


All of This in Your Pocket



KONICA MINOLTA

PERFORMANCE CONSIDERATIONS



Key Qualities of Near-IR Sources for Sensing

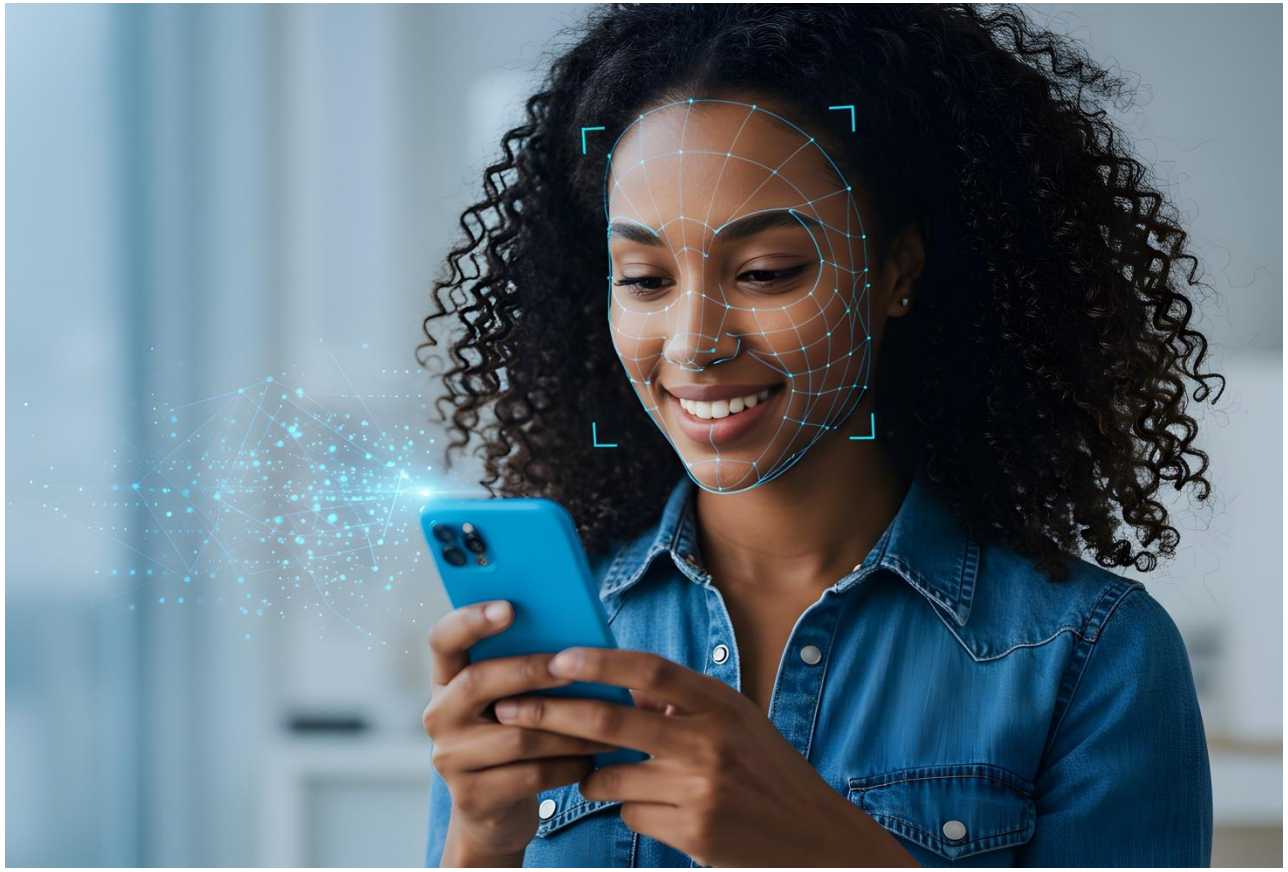
PERFORMANCE INDICATORS

KONICA MINOLTA

Does the device provide enough intensity for sensors to work optimally?

Does the device provide too much light for the human eye to receive safely?

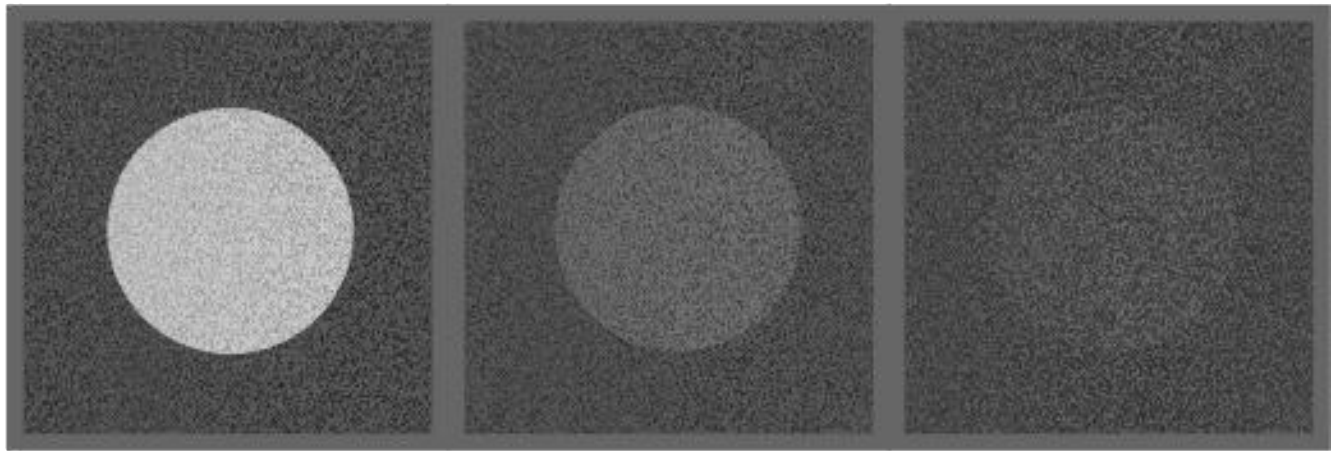
Is the scope or pattern of the NIR light optimized for the application?

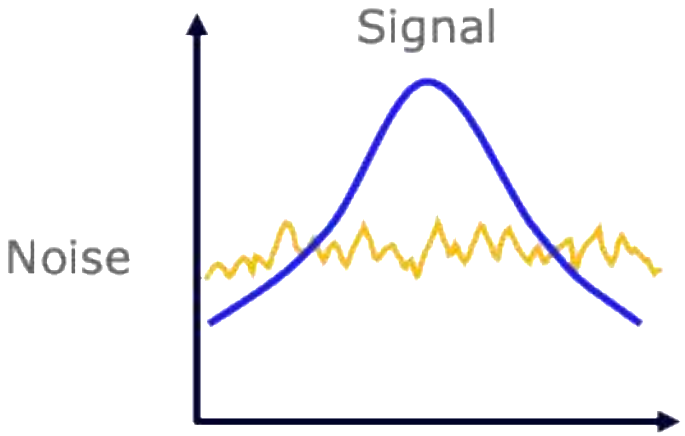


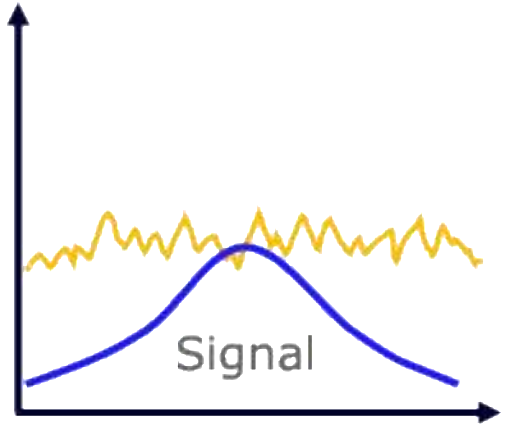
Sufficient Intensity

LED/Laser

IR Camera







Eye Safety

LEDs

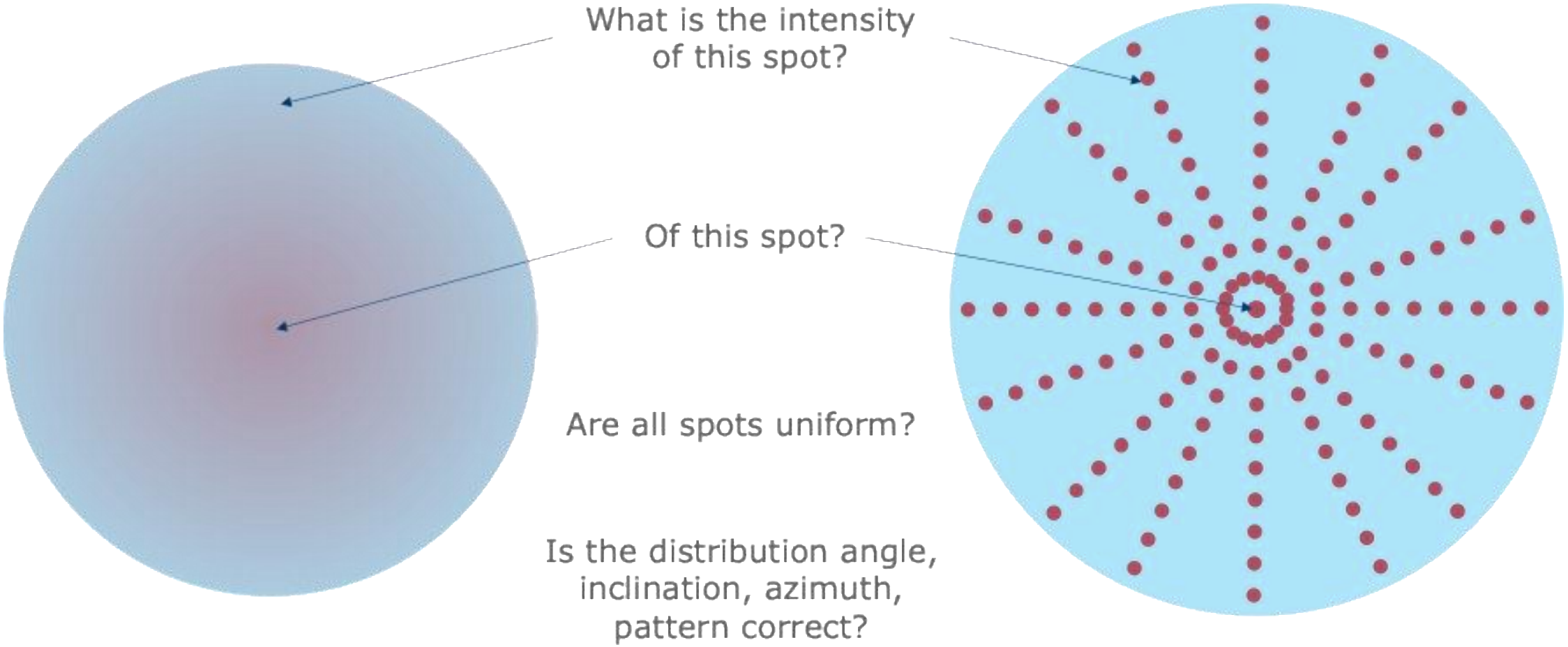
- Considered “intrinsically safe”

LEDs

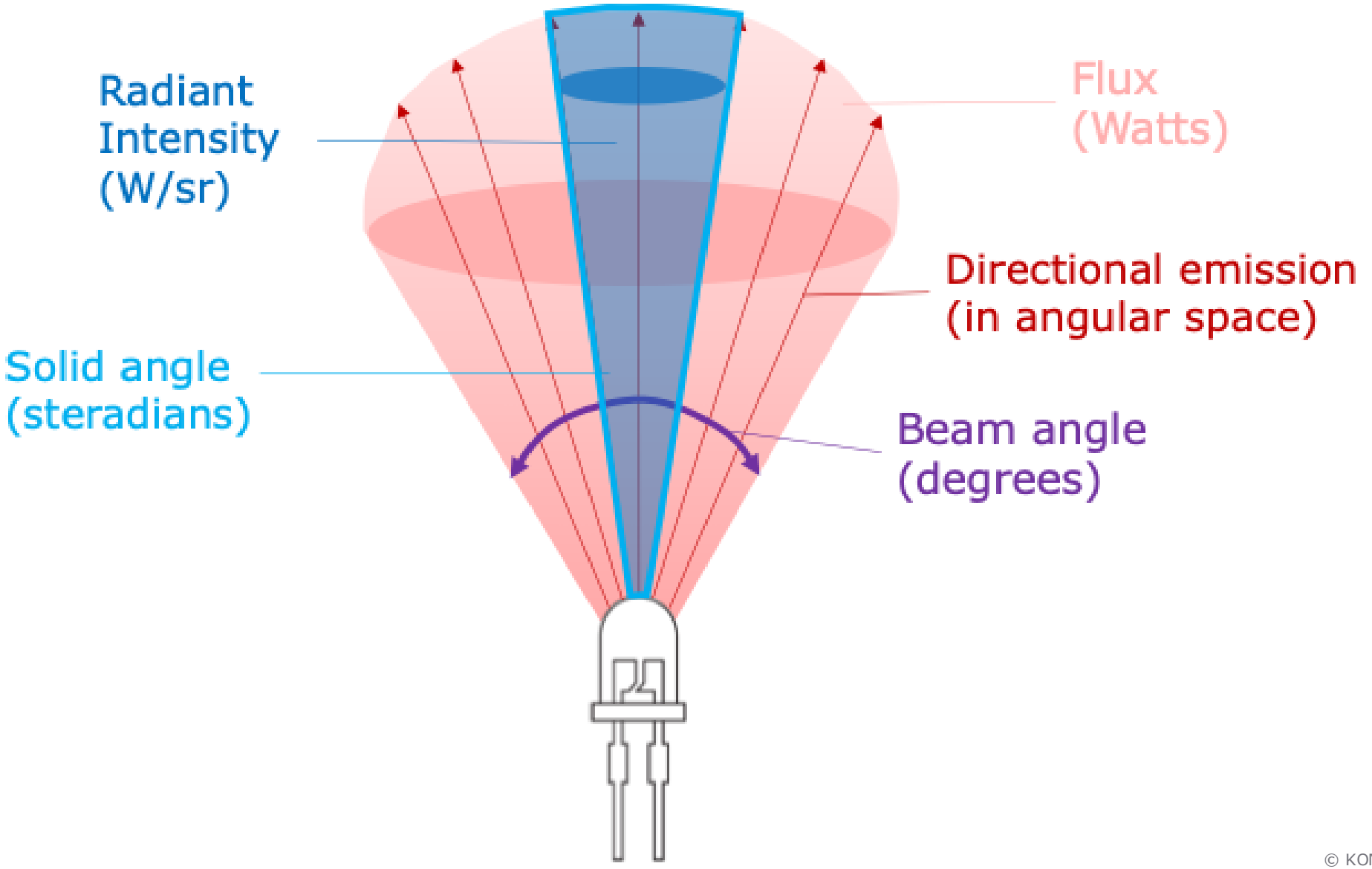
- IEC/EN 60825-1 (read more)
  - Sets maximum permissible exposure (MPE) limits for classes of light sources
  - Dependent on wavelength, exposure time, timing of the source, and source geometry

Measure total power (radiant flux, W) of a distribution/pulse and power at each point (angle, dot) (radiant intensity, W/sr) in the distribution to ensure safe tolerances

Distribution Integrity



Power Over Angle



KONICA MINOLTA

MEASURING NEAR-IR LIGHT SOURCES

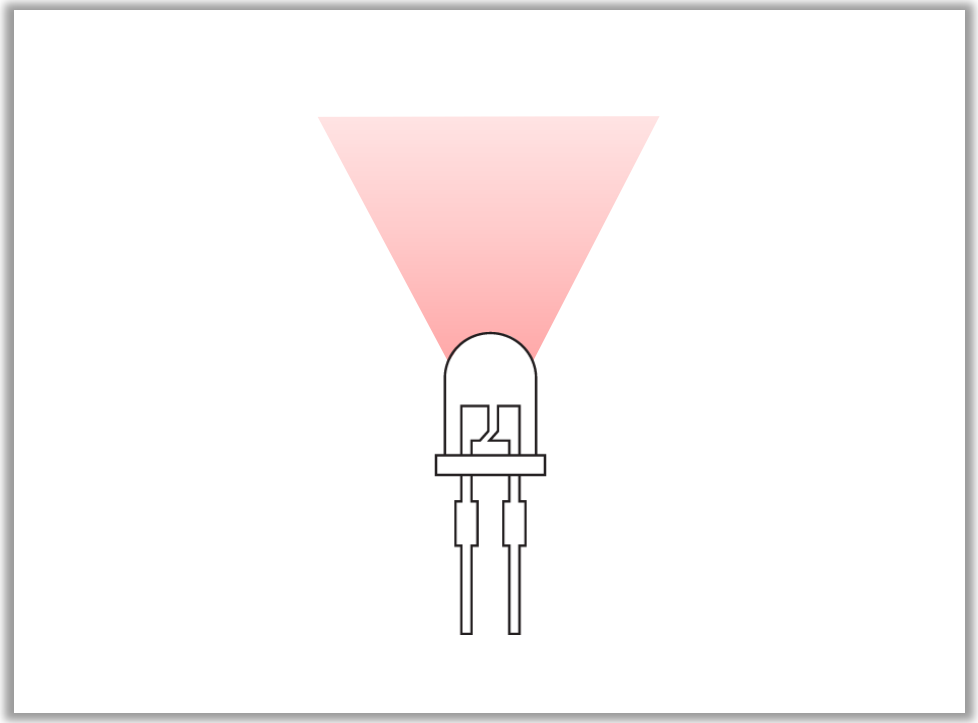
Ensuring Performance of All Lighting Geometries

MEASUREMENT BASED ON LIGHT GEOMETRY

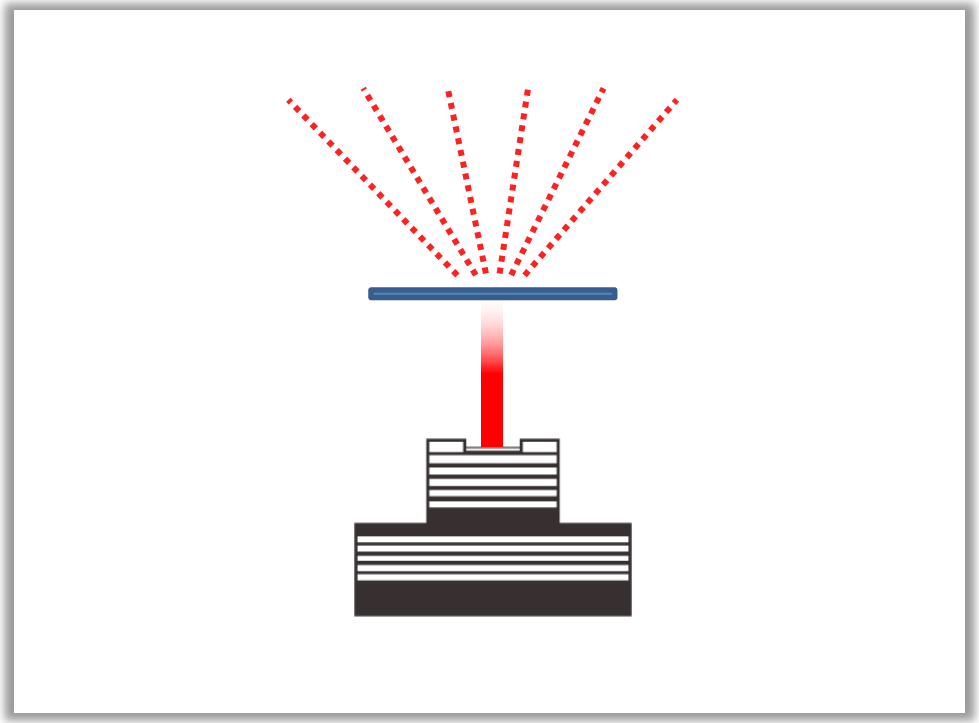
KONICA MINOLTA

MEASUREMENT SOLUTIONS THAT ADDRESS MULTIPLE GEOMETRIC EMISSION SCENARIOS

BROAD ANGULAR DISTRIBUTIONS



STRUCTURED LIGHT PATTERNS



SOLUTION PORTFOLIO SNAPSHOT

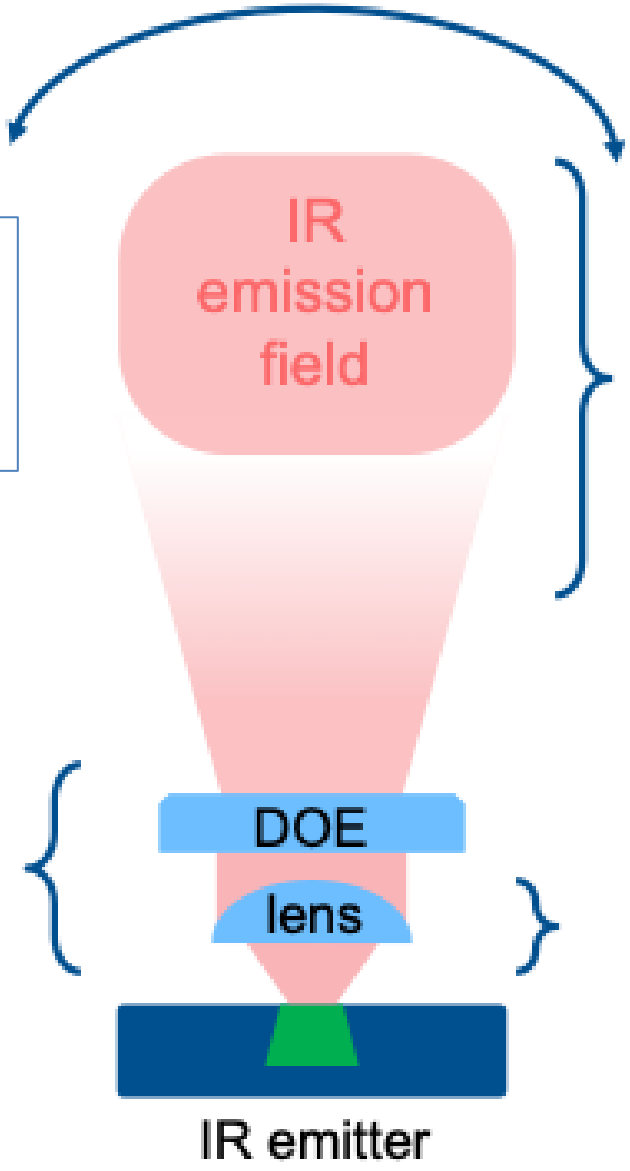
KONICA MINOLTA

3D MEASUREMENT

- Complete spatial radiation profile with high angular resolution

1D MEASUREMENT

- LIV (vs. temperature)
- Spectral analysis (lpeak, FWHM)
- Time-resolved pulse analysis (ns-µs
- Wide measurement range from low to high illuminance
- Improved work efficiency by high-speed measurement



2D MEASUREMENT FAR-FIELD

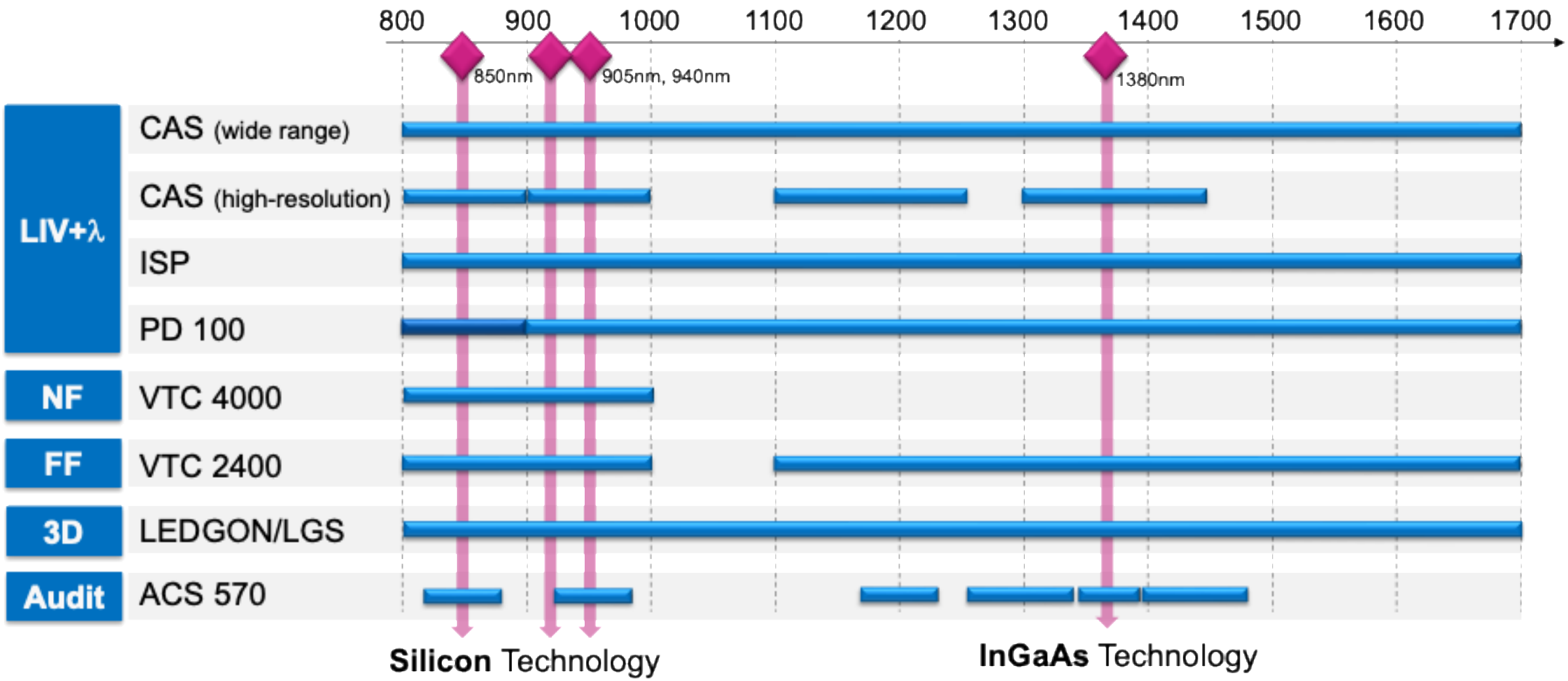
- Beam profile
- Radiant power distribution
- Eye-safety evaluation

2D MEASUREMENT NEAR-FIELD

- Single emitter analysis
- Relative and absolute radiant power
- Divergence, M^2, uniformity
- Polarization properties

SOLUTIONS BY WAVELENGTH

KONICA MINOLTA



KONICA MINOLTA

EMITTERS TO DOE APPLICATIONS

LIV+λ

KONICA MINOLTA

CAS + ISP: COMPREHENSIVE SPECTRAL ANALYSIS

- **Principle:** Array spectrometer with integrating sphere
- **Wavelength range**: 200-1700nm (different models)
- **Optional:** Sphere diameter ranging from 75mm to 250mm
- **Scope:** Radiant power, spectral quantities (FWHM, lpeak,…)
- **Highlight:** High-resolution spectrometer with FWHM < 0.1nm (<0.75nm SWIR)
- **Highlight:** Multi-port ISP allows modular system configuration

PD + ISP: FAST LIV TESTING

- **Principle**: Photodiode with integrating sphere
- **Wavelength range**: 400 – 1700nm
- **Optional**: 1.4 GHz InGaAs photodiode for ns pulse testing
- **Scope**: Radiant power, time-resolved pulse analysis
- **Highlight**: TE-cooled photodiode for high repeatability
- **Highlight**: Self absorption correction (SAC) considers DUT reflectivity

NEAR-INFRARED INTENSITY LENS

SOLUTION COMPONENTS

NIR INTENSITY LENS

Integrated optical component

ProMetric® Y16

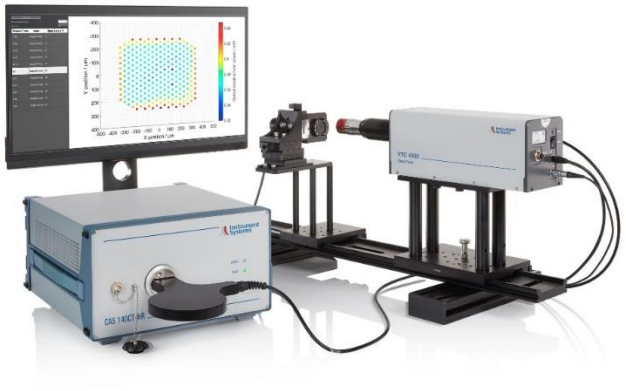
16-megapixel imaging radiometer

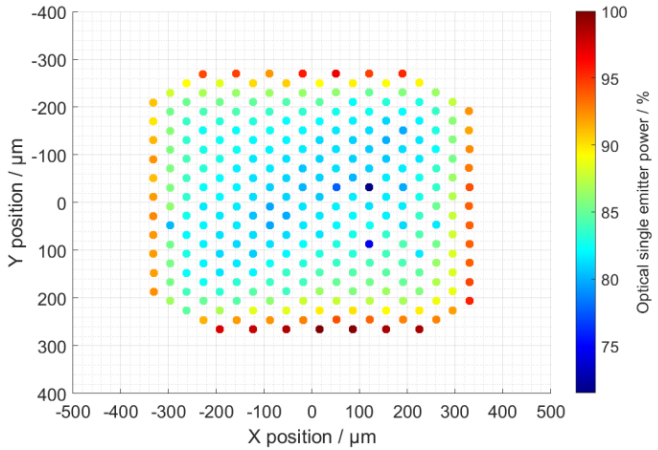
Lens and radiometric imaging system integrated to measure 850/940 nm light sources across angles of ±70 degrees

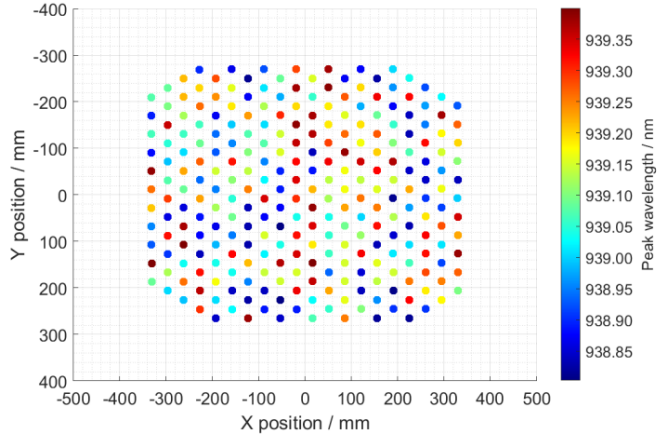
INSTANT MEASUREMENTS

- Using Fourier optics, lens solutions captures a full cone of data in a single measurement
- No need to rotate photodetector or source (laser, LED) to capture distribution of angular light
- Simultaneously measure all angles to ±70˚
- Angular resolution to ~0.05˚ per image sensor pixel

NEAR-FIELD ANALYSIS







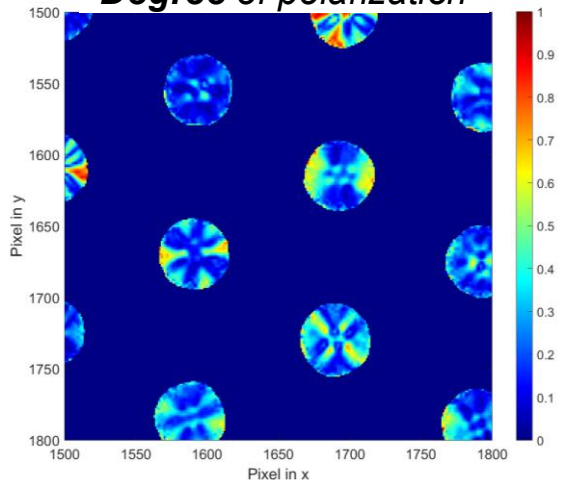
Near-field VTC 4000: One-shot single-emitter analysis

- **Principle:** 2D camera with microscope objective
- **Wavelength range:** 910 - 980nm
- **Optional:** x/y scanning stage for extended field-of-view
- **Optional:** fiber output port for spectral analysis with spectrometer
- **Scope:** Radiant power, M^2, beam waist, focus position, wavelength, FWHM, …
- **Highlight:** Polarization analysis (see next slide)

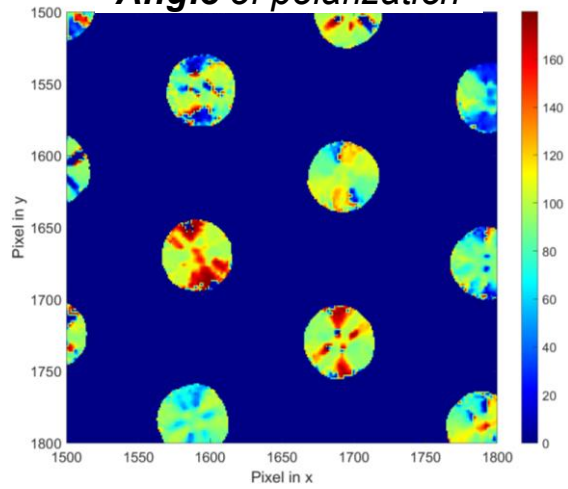
HIGHLIGHT: POLARIZATION ANALYSIS WITH VTC 4000

- Most VCSEL are not designed to emit in a single polarization state
- Using a specific design, e.g. polarization-stabilizing gratings, a controlled polarization can be realized
- Polarized IR illumination is expected to show higher efficiency enabling smaller components

***Degree** of polarization*



***Angle** of polarization*



The VTC 4000 near-field camera allows measuring the degree & angle of polarization for each emitter (“one-shot” measurement)

KONICA MINOLTA

FAR FIELD APPLICATIONS

CL-700A

KONICA MINOLTA

ILLUMINANCE SPECTROPHOTOMETER

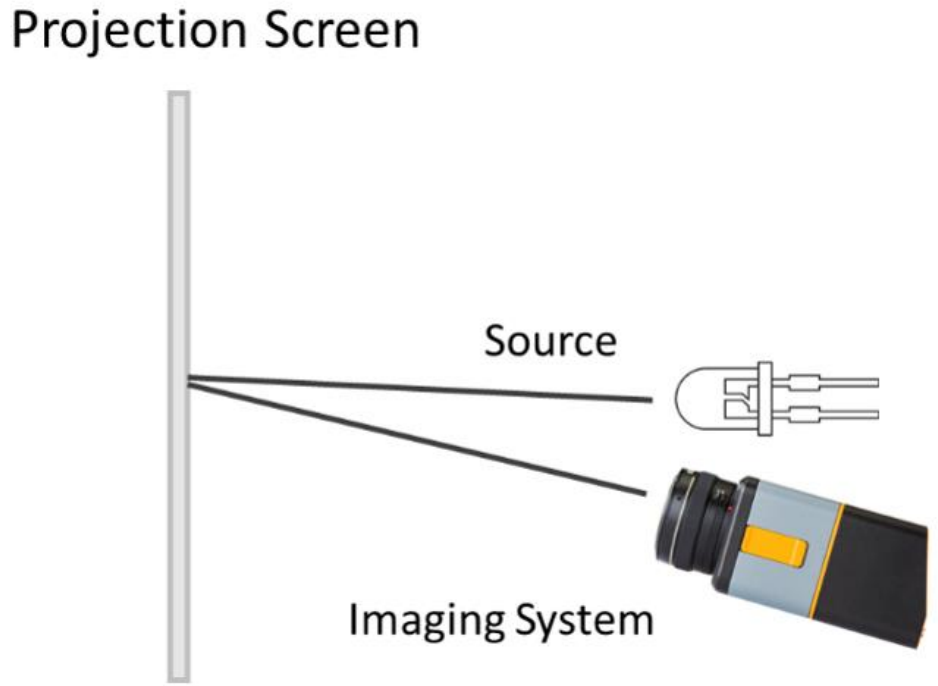
LOW-ILLUMINANCE AND HIGH-SPEED MEASUREMENT OVER A WIDE WAVELENGTH RANGE

1. **Wide wavelength range:** Measure across visible to near-infrared wavelengths
2. **Wide illuminance range:** Measure from ultra-low to high illuminance
3. **High-speed measurement:** Improve efficiency with fast measurement
4. **Simultaneous multi-point measurement:** Measure near-field and far-field
5. **Compact, flexible design:** Use handheld or integrate into equipment
6. **Easy-to-use software:** Simplify measurement and data visualization

BEAM PATTERN MEASUREMENTS

IRRADIANCE ON A WALL:

- Cast dot pattern on a wall/screen and measure with imaging system
- Verify dot position against a target pattern or defined coordinates
- Simple pass/fail on pattern match



GONIOMETER

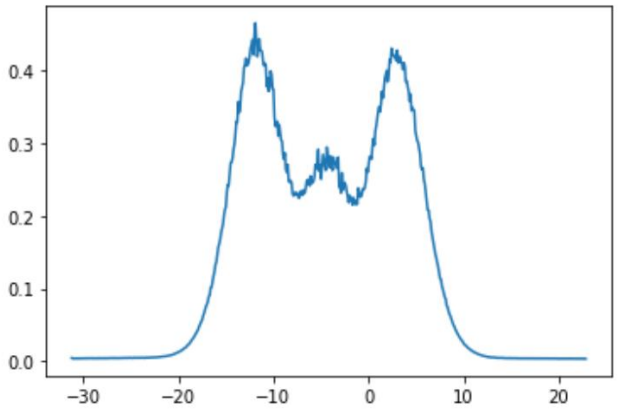
LEDGON: Benchtop Goniometer

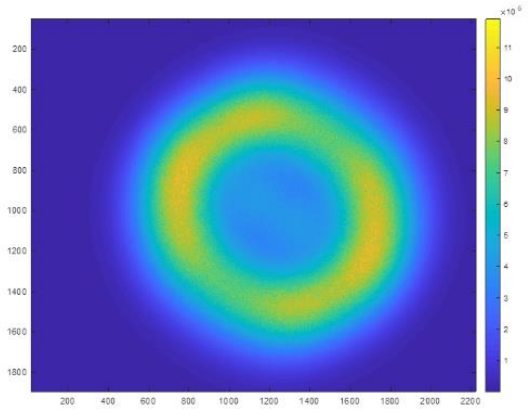
- **Principle:** 2-axis gonio-unit with spectrometer and optical probe
- **Wavelength range**: 200-1700 (depending on spectrometer model)
- DUT size from single emitter to small modules (<0.7kg)
- Angular resolution < 1° and full 180° measurement angle
- **Scope:** Radiant intensity distribution, radiant flux, spectral quantities
- **Highlight:** Light proof housing for easy lab integration

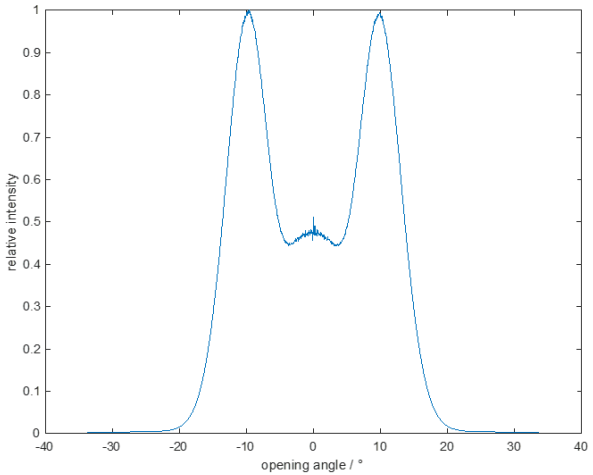
LGS Series: Reference station

- **Principle:** 2-axis gonio-unit with spectrometer and optical probe or photometer
- **Wavelength range:** 200-1700 (depending on spectrometer model)
- DUT size from single emitter to large modules (< 8kg)
- Angular resolution < 0.01° and full 180° measurement angle
- **Scope:** Radiant intensity distribution, radiant flux, spectral quantities
- **Highlight:** Fully automated high-resolution goniometer

FAR-FIELD ANALYSIS







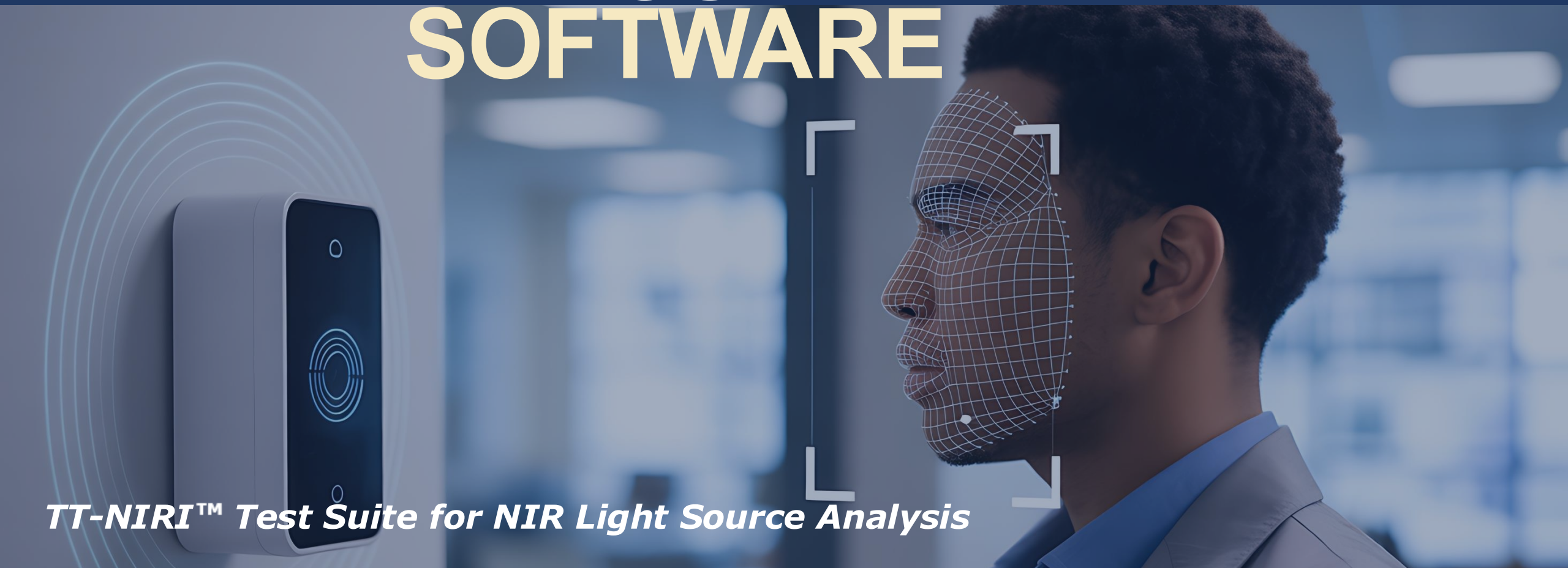
Auto detection for highest intensity within area

Far-field VTC 2400: Beam profiling

- **Principle:** 2D camera with transparent panel
- **Wavelength range:** 800 – 1000nm
- **Panel size:** Standard 100x100mm² (other sizes on request)
- **Optional:** Lightproof production housing
- **Scope:** Radiant power, beam profile, hot spot detection
- **Highlight:** Eye-safety analysis in LumiSuite Software
- **Highlight:** Traceable radiometric calibration

KONICA MINOLTA

MEASUREMENT SOFTWARE



TT-NIRI™ Test Suite for NIR Light Source Analysis

TRUETEST LIBRARY

KONICA MINOLTA

Test Library

TT-NIRI includes tests for near-infrared (NIR) laser and LED Measurement:

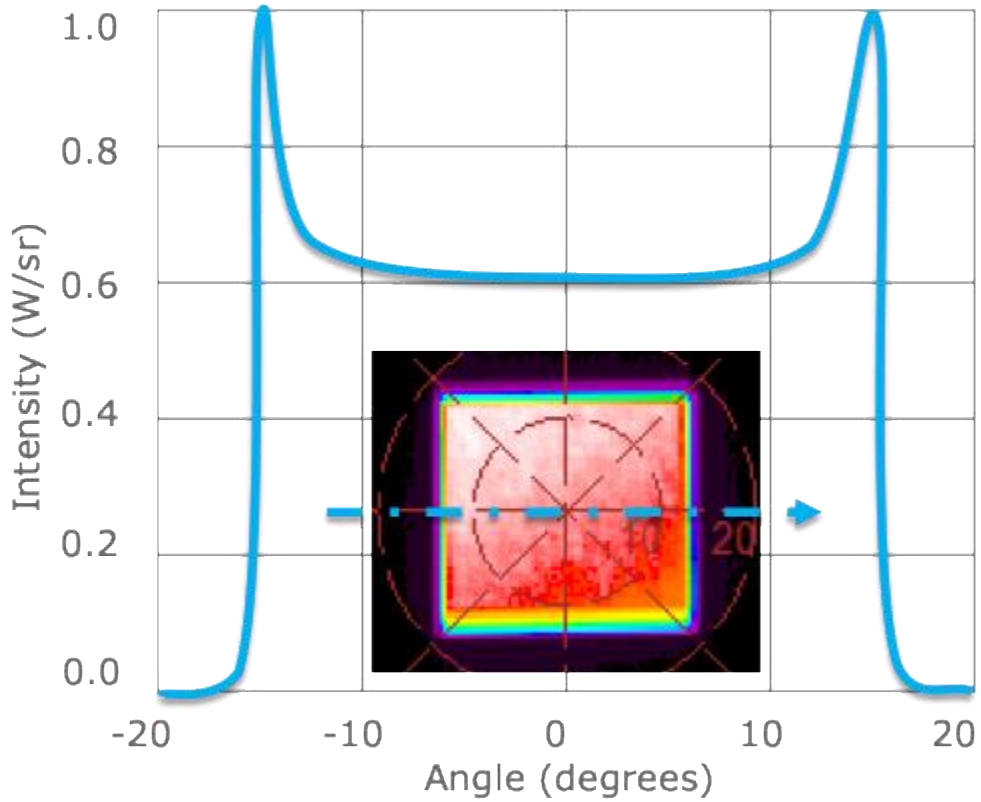
- Total Flux (mW or W)
- POI Total Power
- Max Power
- Pixel Solid Angle
- Dot Source Analysis
- Flood Source Analysis
- Points of Interest
- Image Export

Captures highly accurate emission measurements reported in radiant intensity (as a function of angle). Dot Source Analysis automatically outputs CSV files containing data for the entire sample, data for each region of interest, and data for each dot.

FLOOD SOURCE ANALYSIS

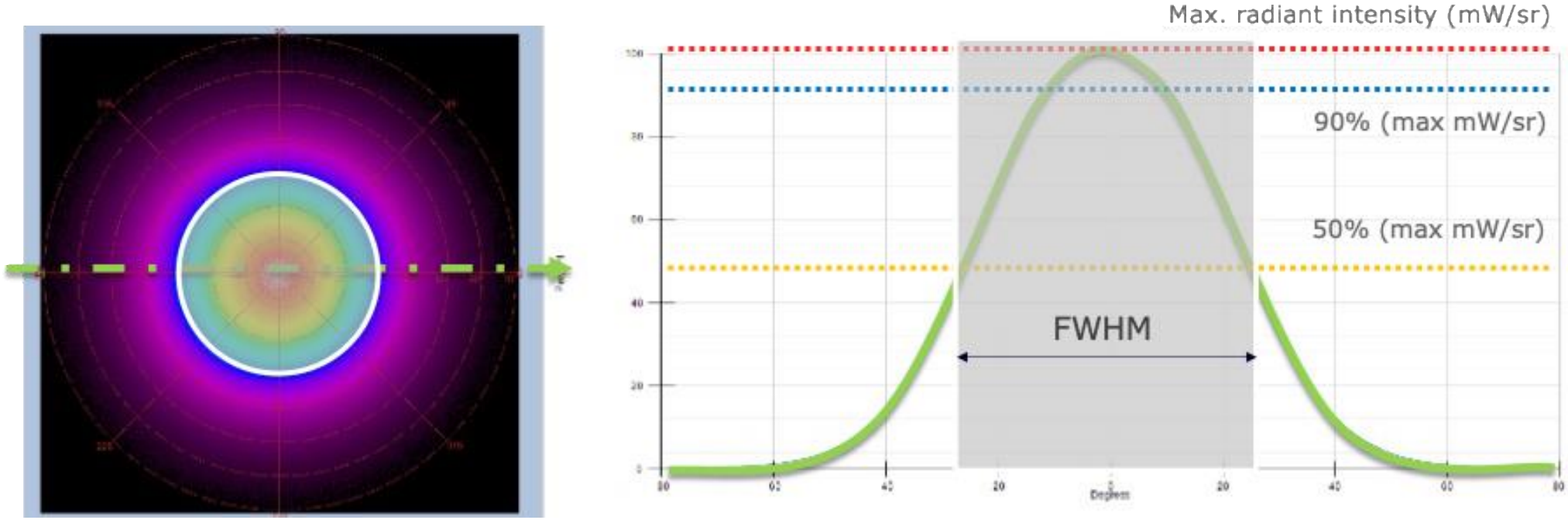
Analyze distributions:

- Uniformity across angular emissions (intensity at each degree)
- Center values
- Angular fall-off
- Hot-spots



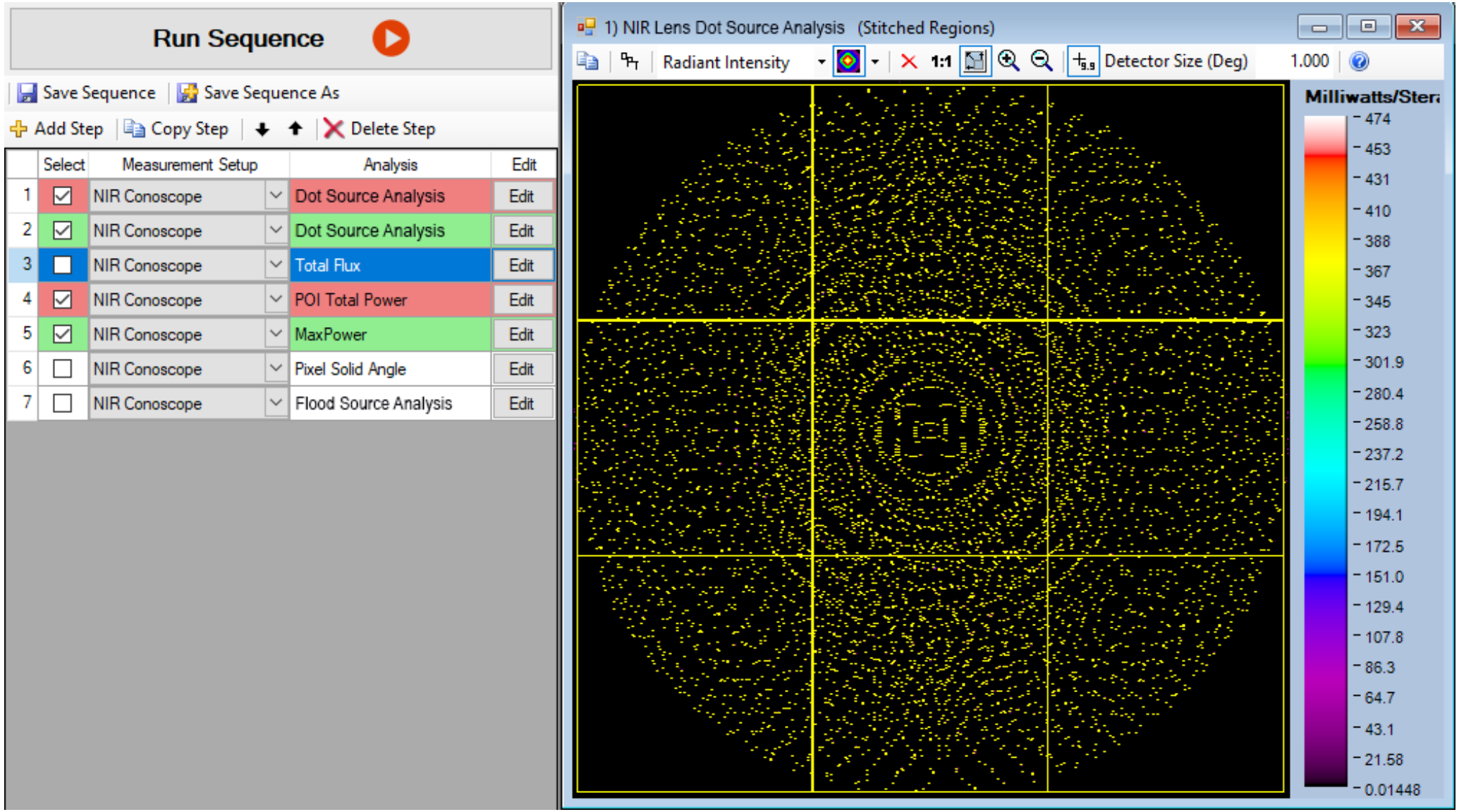
ANGULAR DISTRIBUTION MEASUREMENT

Full-width half-max (FWHM) of the angular cross-section defines the primary area for intensity measurement.



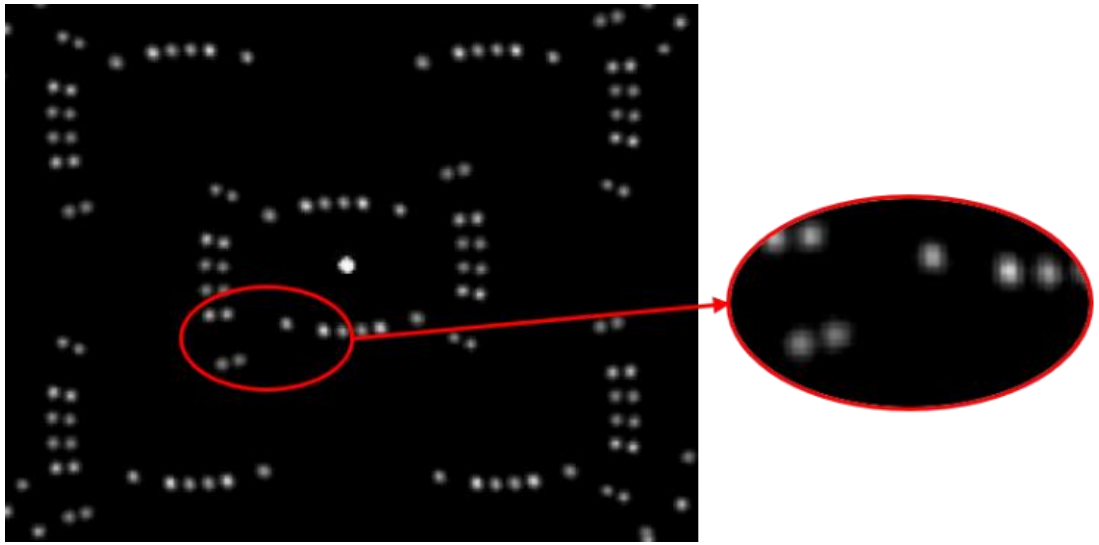
DOT SOURCE ANALYSIS

KONICA MINOLTA

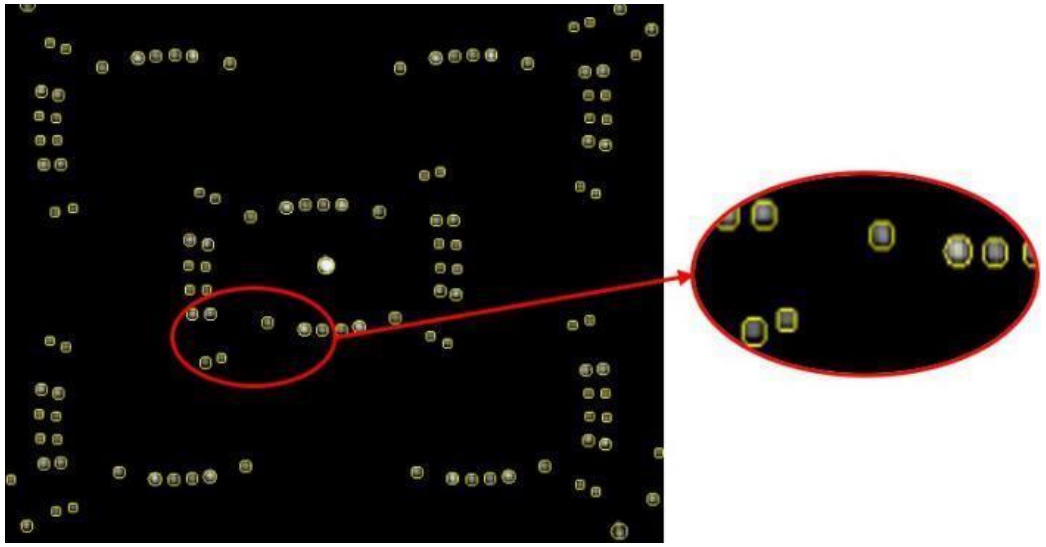


DOT SOURCE ANALYSIS

SOFTWARE AUTOMATICALLY DEFINES POINTS OF INTEREST



BEFORE ANALYSIS

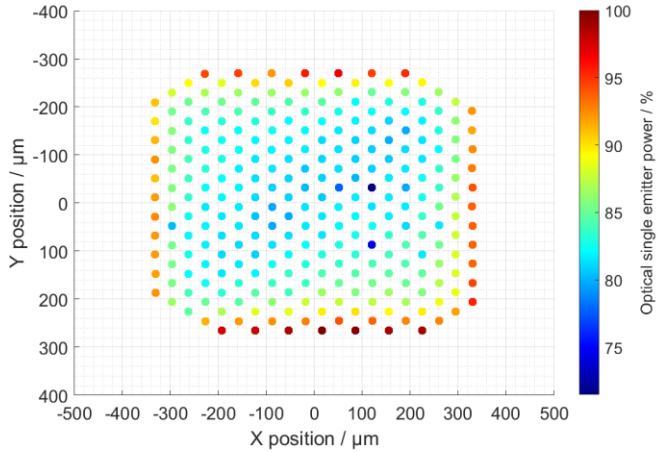


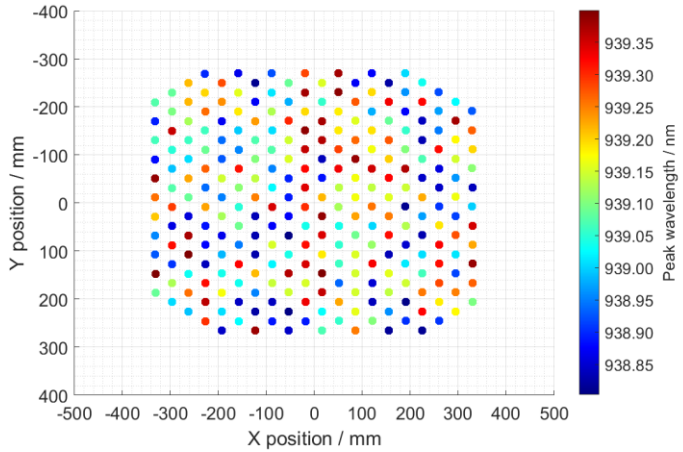
AFTER ANALYSIS

VTC SOFTWARE

Single emitter analysis

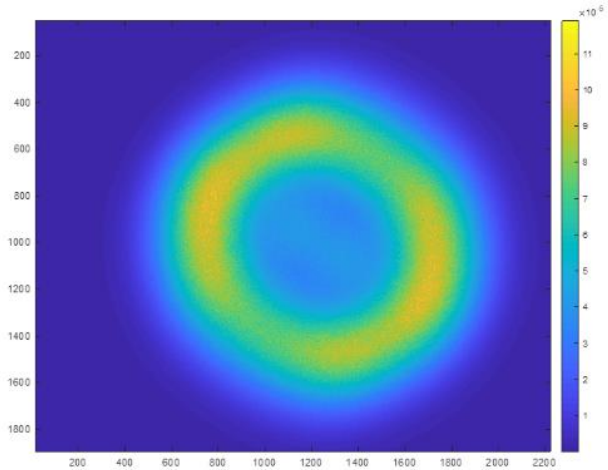
- x/y position determination
- Total power
- Polarization analysis
- Diameter in focus position
- Focus position
- NA, M²
- Peak wavelength

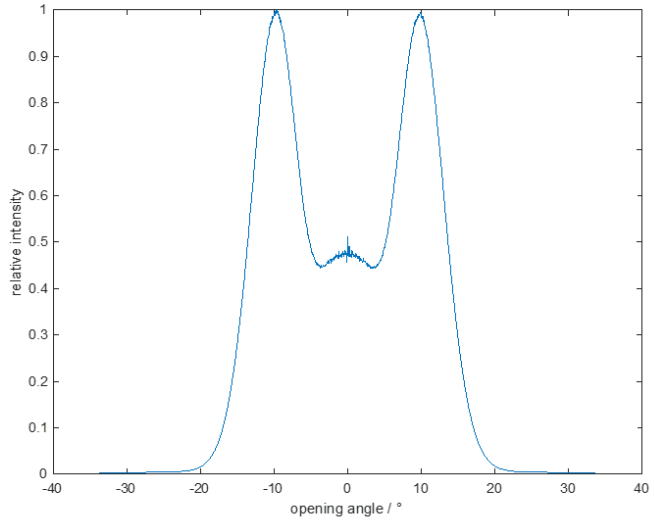




Beam profiling

- Total power
- Irradiance measurement
- Second moment, D86
- Laser eye safety relevant power (7mm aperture @100mm distance)



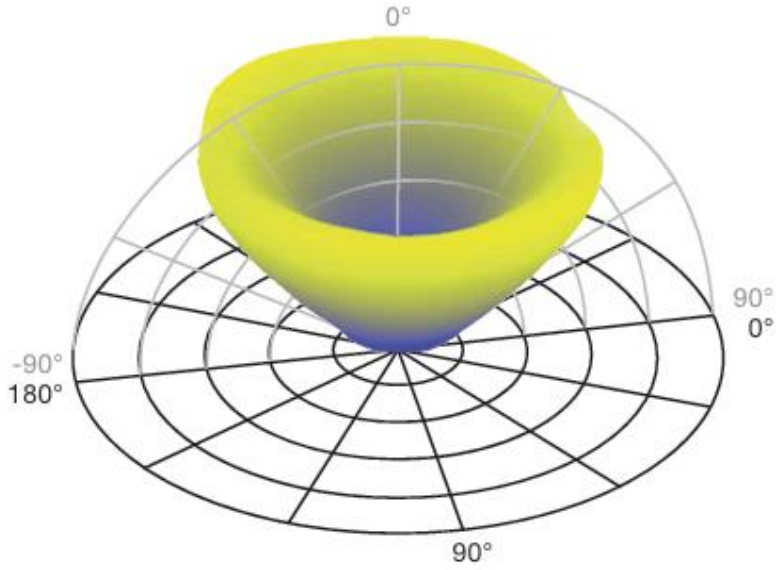


LEDGON 100 / LGS 1000

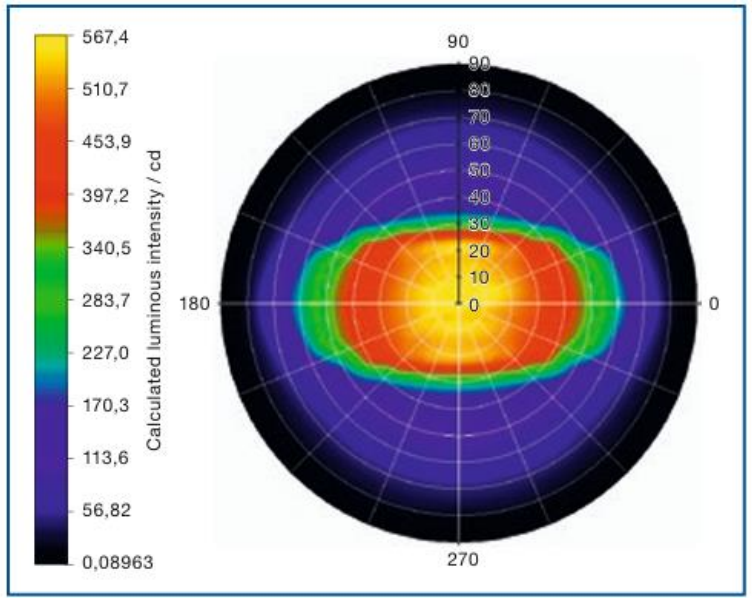
CONTROL AND EVALUATION WITH SPECWIN PRO

Sequence mode allows the radiation pattern of the test specimen to be recorded for the two spatial axes (theta and phi) at equidistant angular increments.

Test series mode permits free definition of test sequences, i.e. measurements at any definable sequences of angular positions.



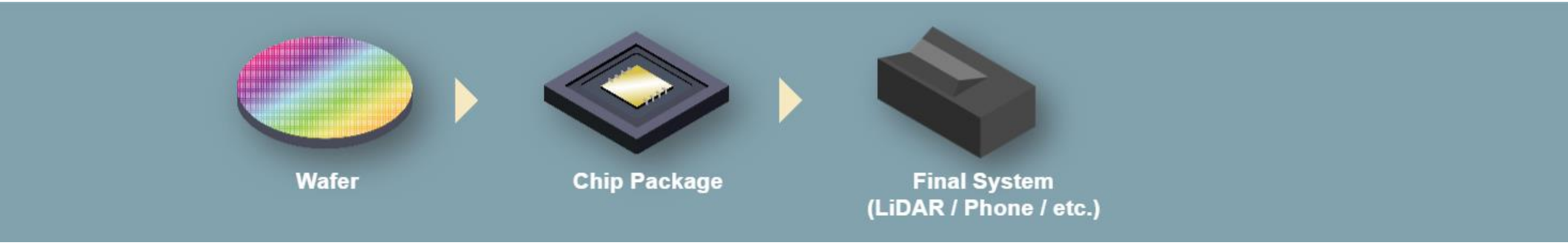
SpecWin Pro 3D radiation pattern



Intensity distribution in spherical display

ACROSS THE VALUE CHAIN

FROM R&D TO PRODUCTION



Capture & compare measurement data to ensure development accuracy

- Characterize sources/component in the lab for engineering and development
- Use R&D data as benchmark during production for quality control
- Transition to faster takt-time solutions for production with pass/fail metrics based on benchmark data
- Easily transition data files saved through common software environments


KONICA MINOLTA
Thank you!


KONICA MINOLTA