PURE SPECTRA

Passion for prisms

Spectronet Conference @ TKH
Dick Goudriaan

SEPT 2025

Introduction and Problem Statement

Why Multispectral Imaging?

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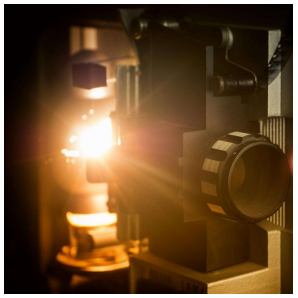
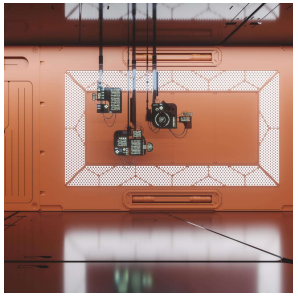


Challenges in Traditional Vision

Traditional machine vision struggles with varying lighting and material differences, causing inconsistent results in real environments.



Limitations of Hyperspectral Imaging

Hyperspectral imaging offers detail but is often too complex, costly, and data-heavy for everyday applications.

Advantages of Multispectral Imaging

Multispectral imaging balances spectral resolution with cost and processing efficiency, ideal for dynamic, real-world uses.

No Perfect Conditions: Why Sensor Design Must Adapt

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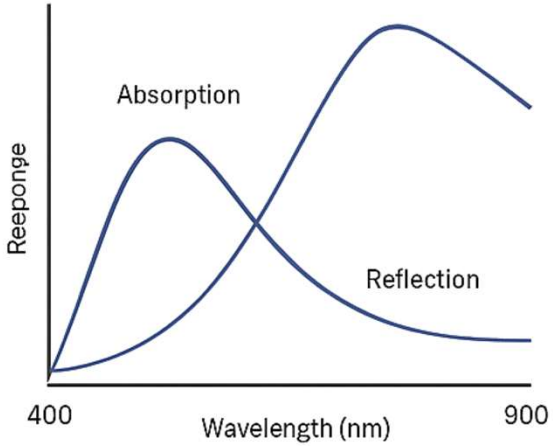
Ideal conditions: controlled lighting, dark materials, low speed

Reality: variable lighting and material response



Material response varies with wavelength

Real-World Demands vs. Practical Solutions

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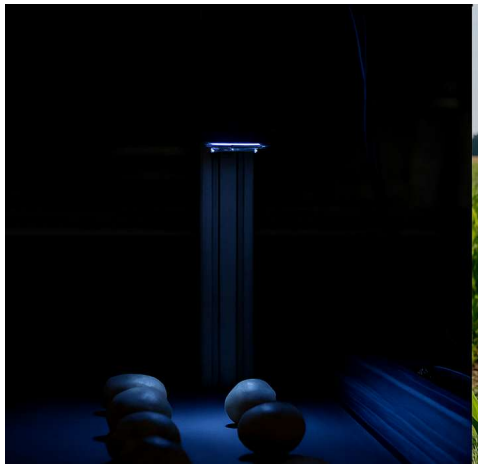
Challenges in Real-World Environments

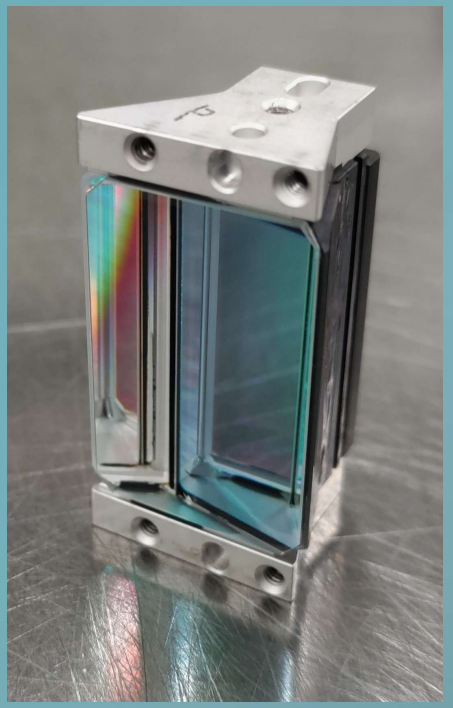
- 🔴 Controlled environments
- 🌞 Natural light & material variability
- ⚠️ Single-sensor limitations



PURE SPECTRA's Approach

- ✅ Production control advantage - 2-4 wavelengths is sufficient
- 🚫 No need for full hyperspectral systems
- 🎯 Targeted spectral signatures

Technology Overview



Philips Prism Technology

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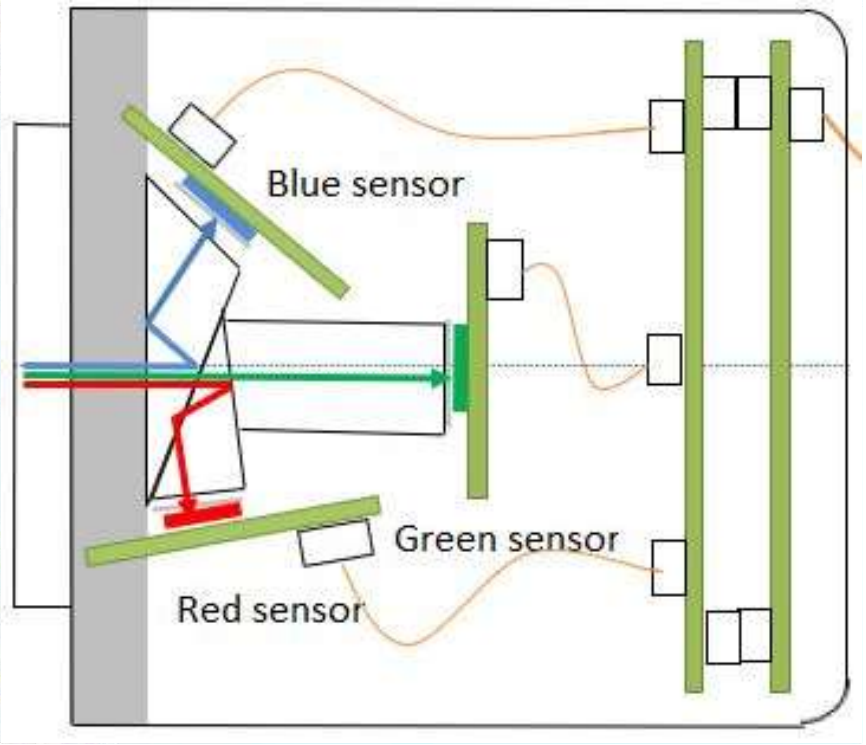

Multispectral Imaging Evolution

Philips Prism Technology evolved from 1970s color separation to advanced multispectral imaging solutions with multiple sensors.

Pixel-Level Spectral Alignment

Technology ensures pixel-level alignment across spectral bands, providing high spatial accuracy in imaging.

Dual-Mode Absorption and Reflection

Captures absorption and reflection wavelengths simultaneously, enhancing dynamic range and spectral fidelity.

Real-Time High-Precision Data

Simple, effective prism-based splitting enables real-time acquisition of high-precision spectral data without complexity.

Enter Philips Prism Technology|: **From Legacy to Innovation**

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🕰️ **Developed in the 1970s** for color separation in imaging

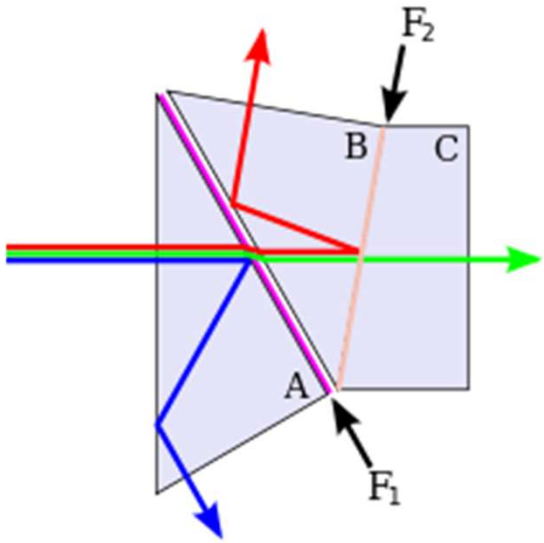
🔄 **Modern evolution**: Prism-based splitting enables simultaneous use of **2-4 sensors**

Why It Matters

🎯 **Pixel-level alignment** across spectral bands

🔍 **Simultaneous imaging** of absorption & reflection wavelengths

📈 **Enhanced dynamic range** and **spectral fidelity**



"Prism-based light splitting enables simultaneous spectral capture"

Application Areas

Use Case: Agriculture

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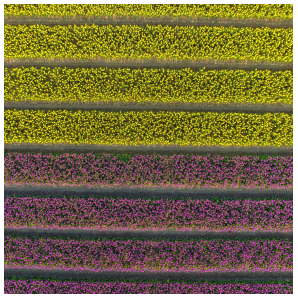
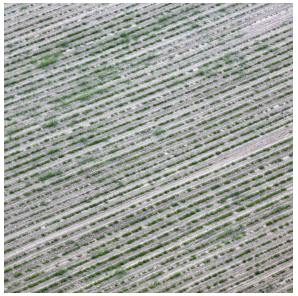


Crop Monitoring Precision

Multispectral imaging detects ripeness, defects, and stress in crops with high accuracy.



Real-Time Decision Making

Fusing pixel data from multiple spectral bands enables immediate decisions to improve yield and reduce waste.

Field-Ready Imaging Systems

Compact, embedded prism-based imaging systems allow continuous monitoring under varying field conditions.

Applications in Agriculture

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🌾 Advantages

Detect ripeness, defects, and stress with multispectral precision

Make real-time decisions using fused pixel data

📌 Use Cases

Fruit sorting

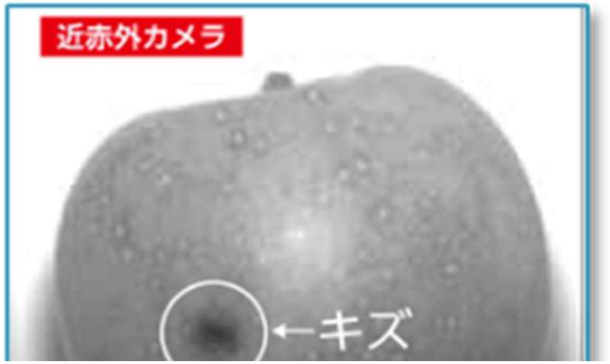
Crop health monitoring

Soil analysis

🚜 Deployment

Compact, embedded systems designed for field use

Robust performance under variable lighting and environmental conditions



Use Case: Industry

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Leak Detection Accuracy

Multispectral imaging accurately detects oil and water leaks using a 1300nm bandpass filter with clear spectral difference.

Cost-Effective Alternative

Multispectral imaging is more affordable and scalable than complex hyperspectral systems for high-volume industrial applications.

Real-Time Inspection

Supports real-time monitoring and quality control in environments where traditional sensors may be inadequate.

Detecting oil vs. water leaks in industrial environments

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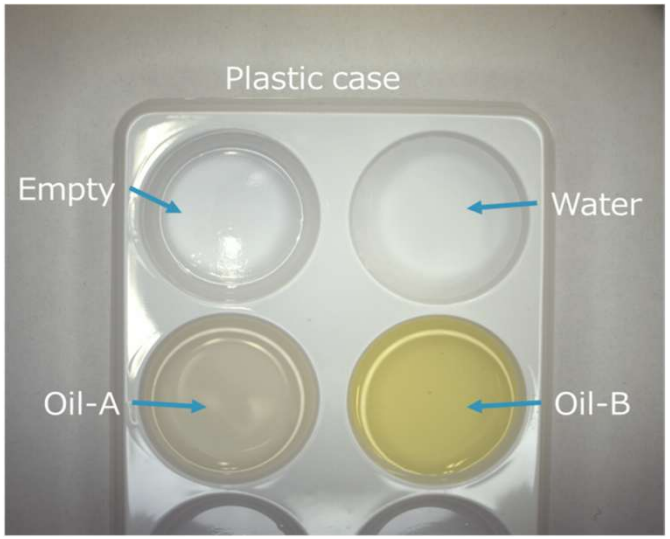
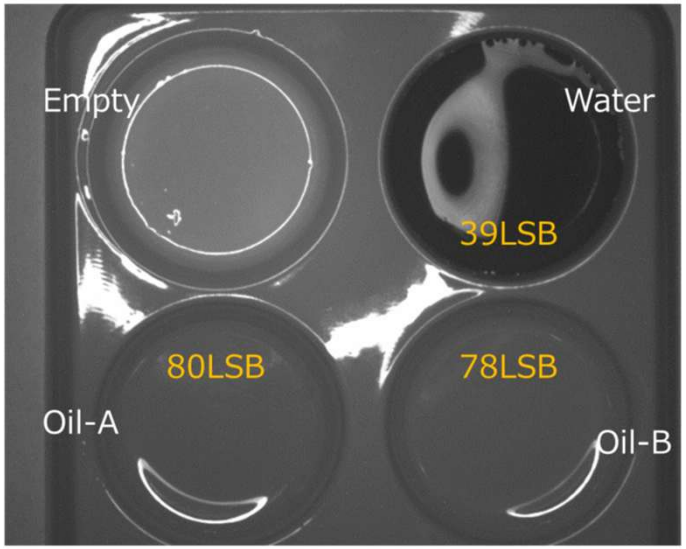
- Solution:
  Multispectral imaging using transmission and reflection
- Case Study:
  1300nm bandpass filter distinguishes oil and water (~40 LSB difference)
- Why Multispectral:
  Affordable, scalable alternative to hyperspectral systems



Halogeen Light Source + 1300nm BPF



There is a difference of about 40 LSB between water and oil.

Detecting oil vs. water leaks in industrial environments

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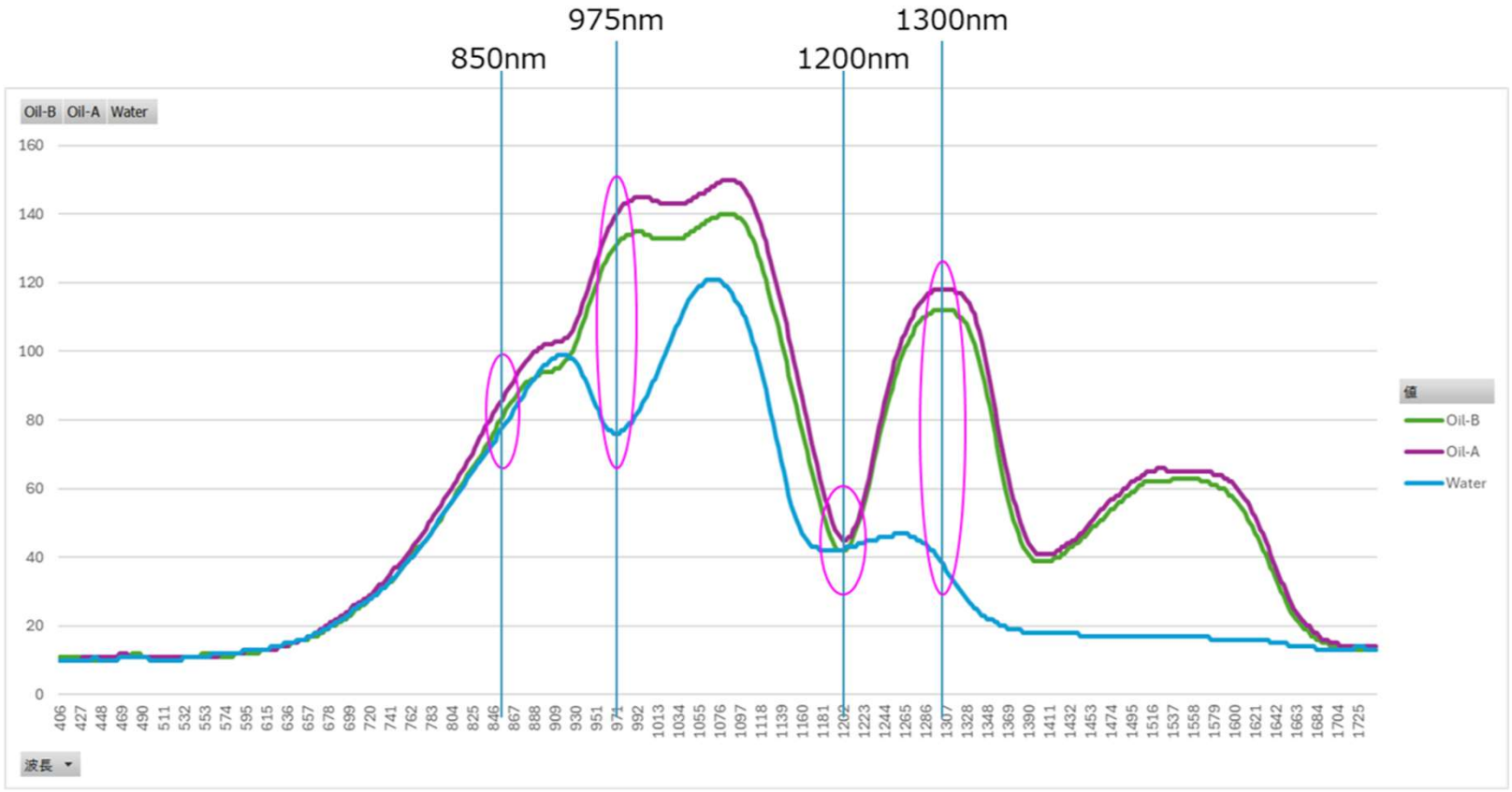

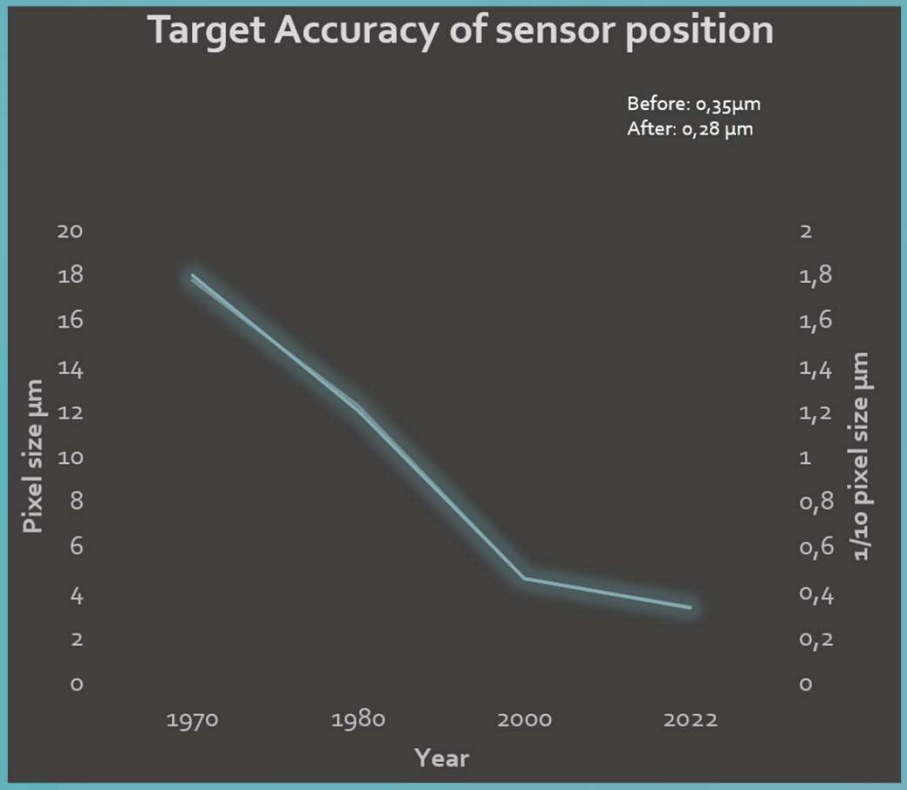

Technical Innovation

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Multispectral Imaging Innovation

Prism-based line scan cameras enable advanced multispectral imaging with high precision and spectral fidelity.

Sensor Bonding Precision

Sensor bonding process ensures precise alignment and stability within the prism assembly for accurate imaging.

Robust and Flexible Design

These cameras are designed for robustness and flexibility, suitable for dynamic, uncontrolled environments.

Technical innovation by NED Prism based Line scan camera

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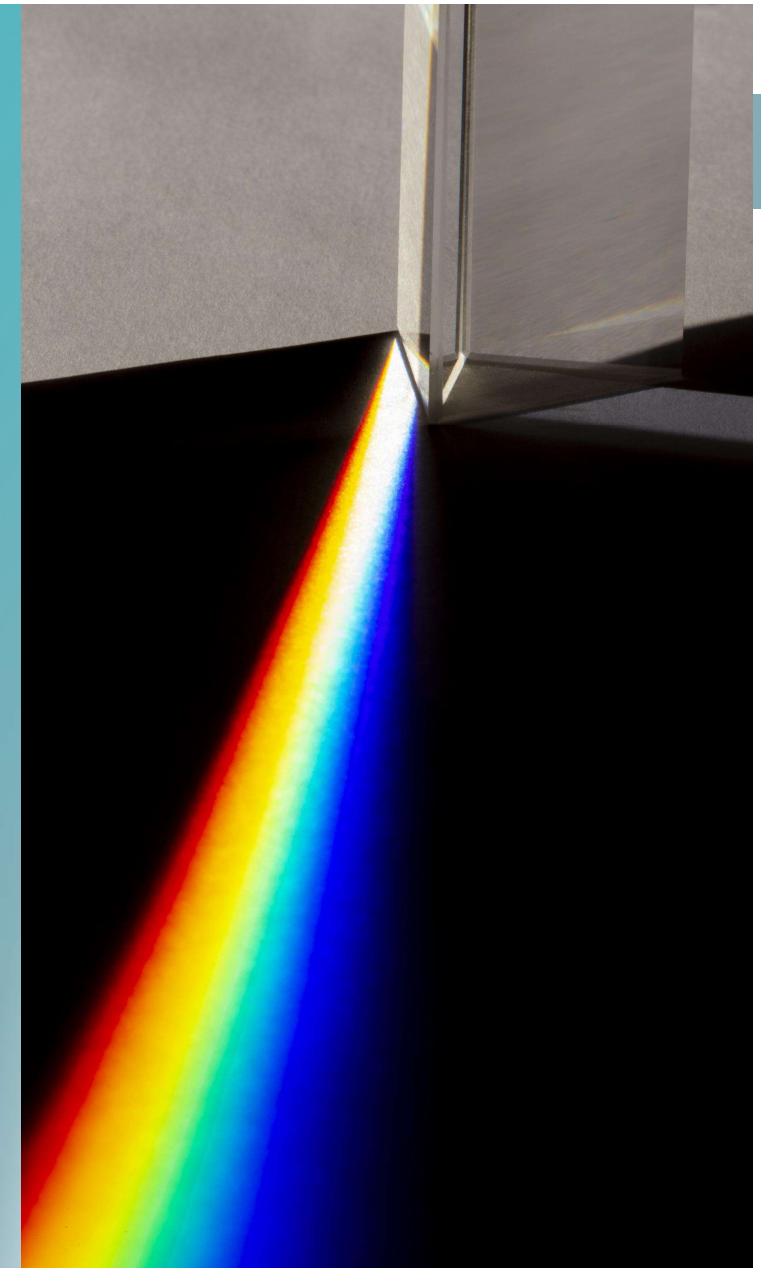
NED
Over 50 years advanced line scan technology from Japan.

	Features	RGB	NIR	SWIR
Optical	Wavelength (nm)	380-700	700-1000***	900-1700***
	Pixel numbers*	2048, 4096		2048
	Pixel size (μm)	2K:14×14, 4K:7×7		12.5×12.5
	Accuracy of pixels (μm)	Less than ± 1.0** (TBD)		

Vision and Future Outlook



Vision for the Future

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Transition to Real-World Uses

Multispectral imaging is evolving from lab settings to practical, real-time industrial applications worldwide.

Multi-Modus Imaging Integration

Combining RGB, near-infrared, absorption, and reflection data enables a comprehensive understanding of materials.

Enhanced Data via Pixel Fusion

Pixel fusion techniques improve data quality, providing more accurate and actionable insights for monitoring.

Solving Photonics Problems Creatively

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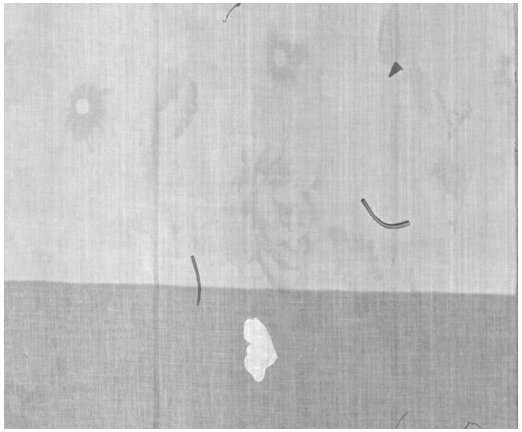
- Photonics meets pragmatism:
- Instead of fighting environmental variation, embrace it with smarter sensor fusion.
- Multi-modus imaging: Absorption + reflection + NIR + RGB = holistic understanding
- Pixel fusion: Not just more data—better data



Vision for the Future

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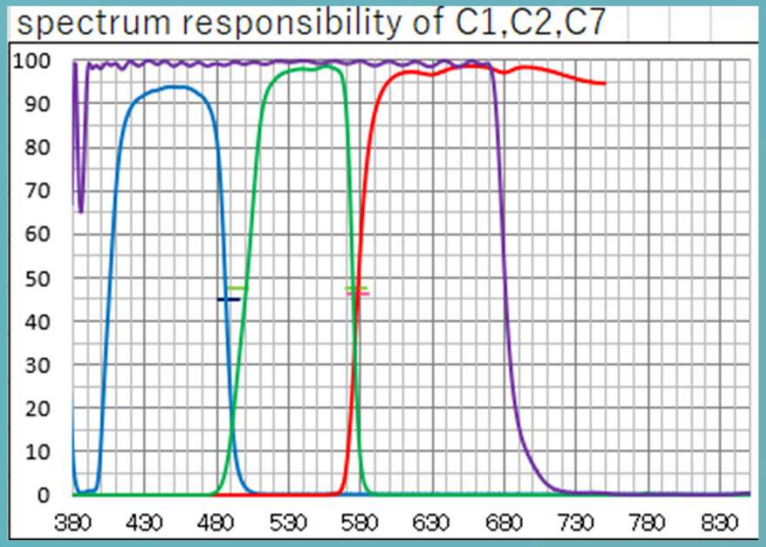
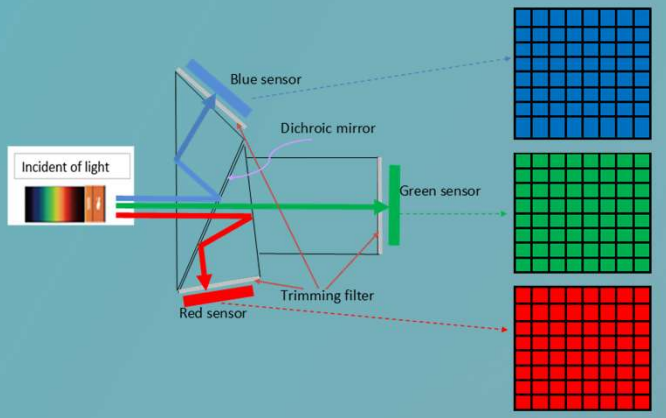
- Innovation: Prism-based 3-/4-sensor line scan cameras for embedded and edge applications
- Scalability: From lab to field, enabling precision agriculture and smart inspection
- Collaboration: Working with NED and other partners to push the boundaries of spectral imaging


spectrum responsibility of C1,C2,C7
100
90
80
70
60
50
40
30
20
10
0
380
430
480
530
580
630
680
730
780
830


Incident of light
Blue sensor
Dichroic mirror
Green sensor
Trimming filter
Red sensor

Products

Products

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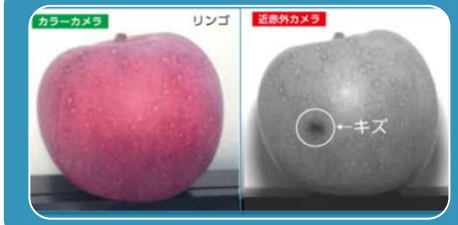
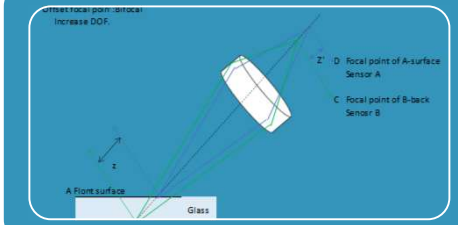
Model 4: High Dynamic Range:

Two sensors with separate shutter control to avoid saturation and obtain linear HDR images.



Model 5 Bayer RGB + SWIR:

Combines visible and short-wave infrared imaging for extended spectral coverage



Model 6 Dual Focus Camera:

Offset focal planes allow inspection at multiple depths with limited depth of field.

Products

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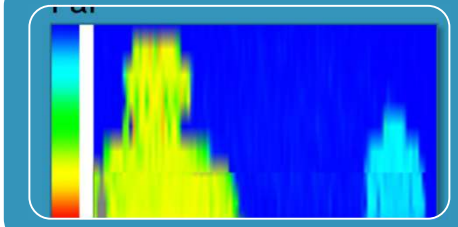
Model 8 Two independent shutters:

PIV principle—each sensor acts as an individual camera with time-domain variation



Model 9 Bayer RGB + TOF Area Sensor:

Enables 3D imaging using Time-of-Flight technology and reflective area detection.

Bayer RGB + Polarized Sensor:

Combines spectral and polarization data for advanced material analysis.

Conclusion

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Invitation to Explore

Encourages exploring multispectral imaging possibilities with innovative prism-based solutions.

Diverse Applications

Highlights applications in agriculture, industry, and research using multispectral technology.

Future Collaboration

Invites collaboration to advance and shape the future of imaging technologies together.

Our Core technology

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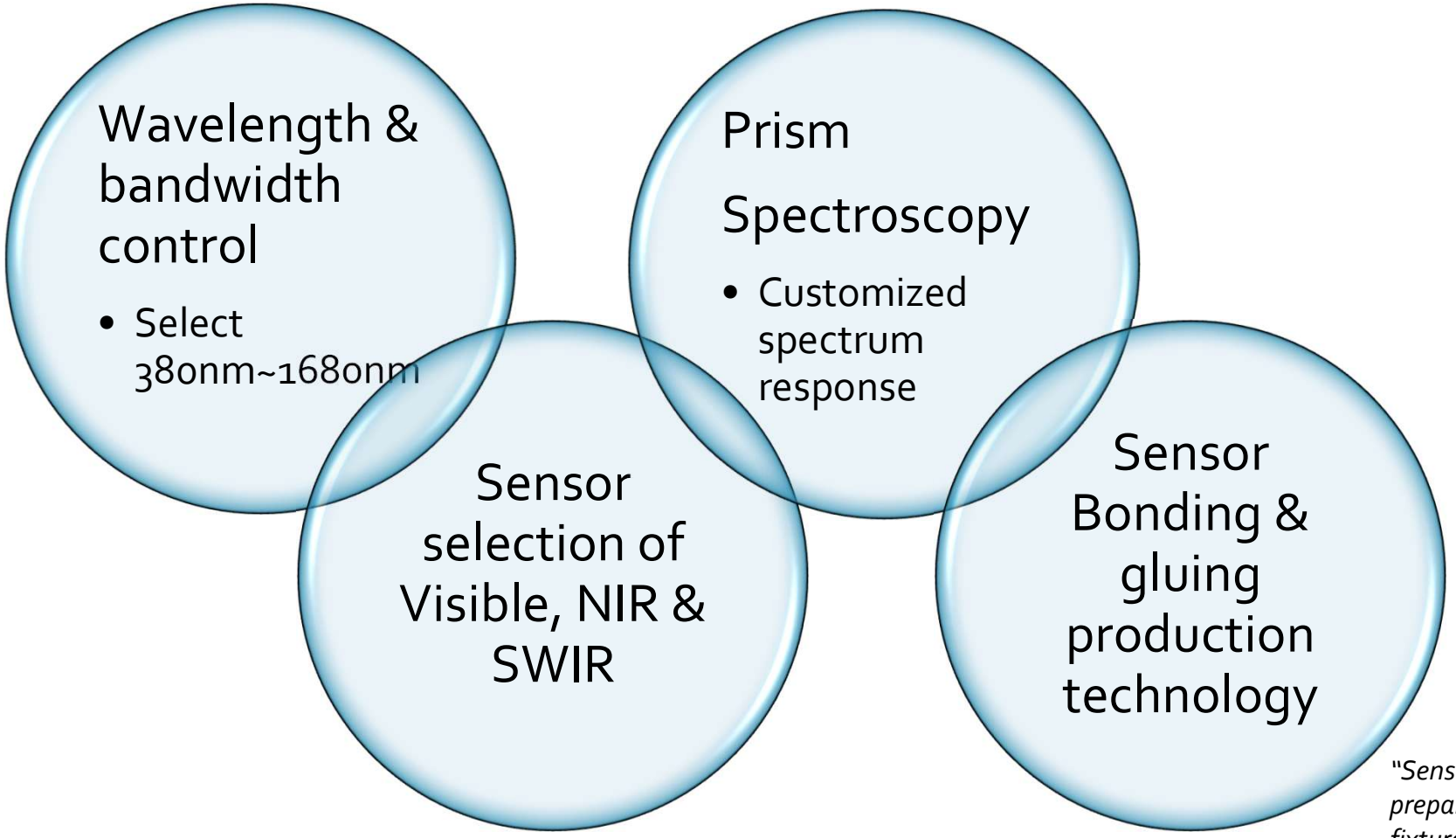

"Sensor Bonding" is the process of preparing the prism and the fixtures.

APPLICATION C4 - High dynamic range

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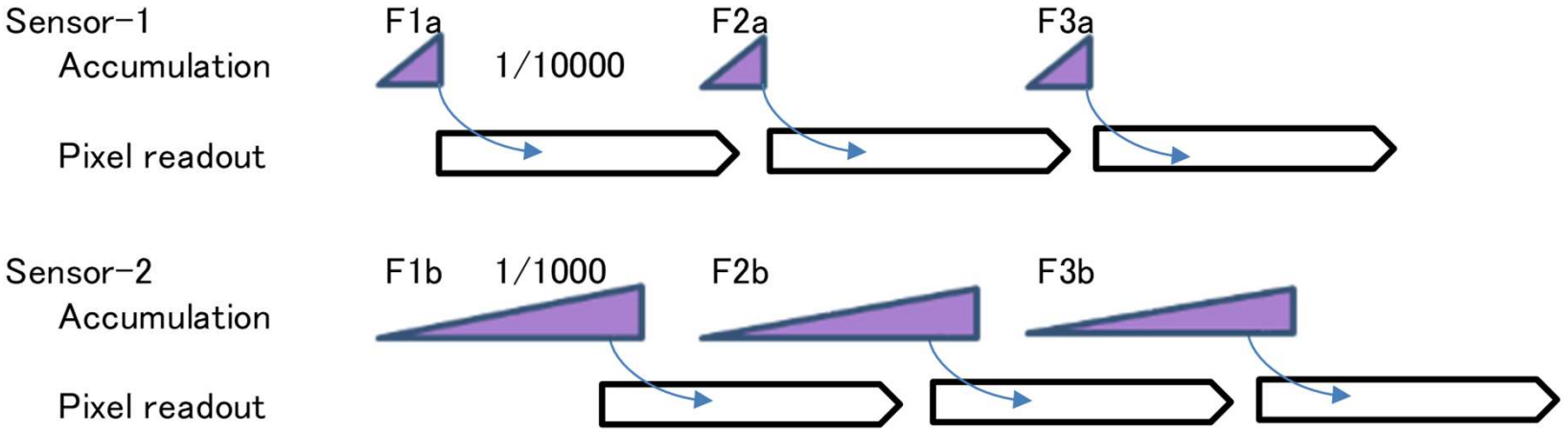
High-Dynamic Range operation



High transmittance

Low transmittance

Images with different sensitivities can be obtained at the same time
The linearity of the HDR image is larger then of a single image.

Nikon | Imaging Products | DSLR Camera Basics | Setting Exposure: Shutter Speed and Aperture

APPLICATION 8 - PIV principle

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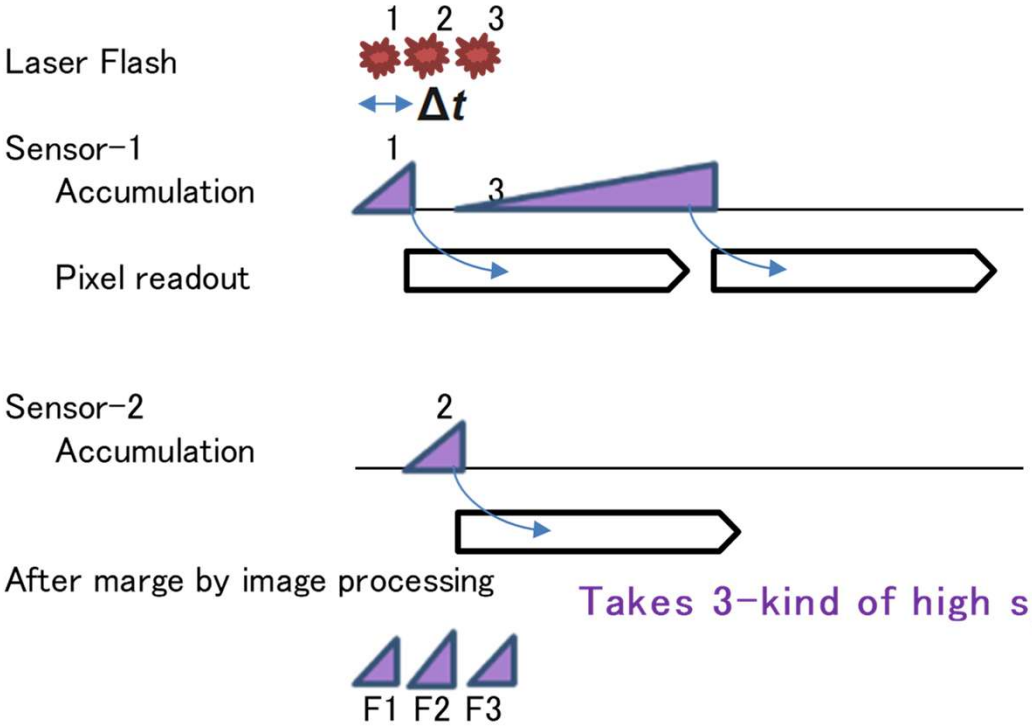
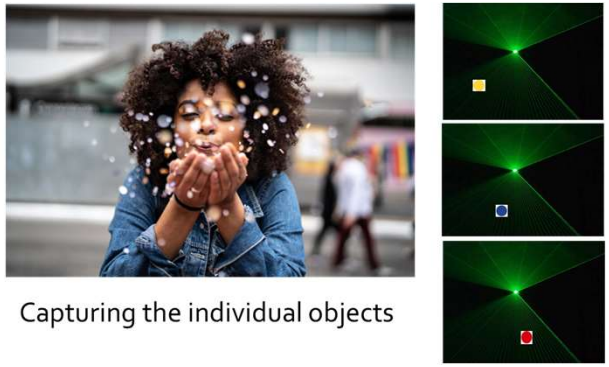
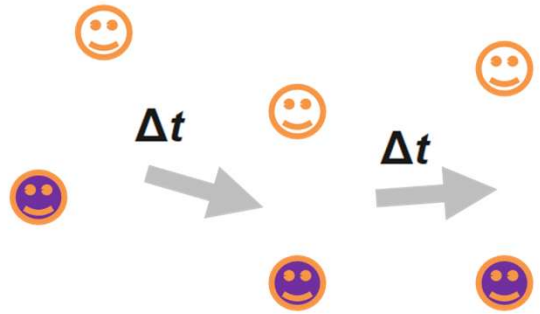


Takes 3-kind of high speed fluid phenomena



Capturing the individual objects

Particle Imaging Velocity



MODEL 4: High dynamic range

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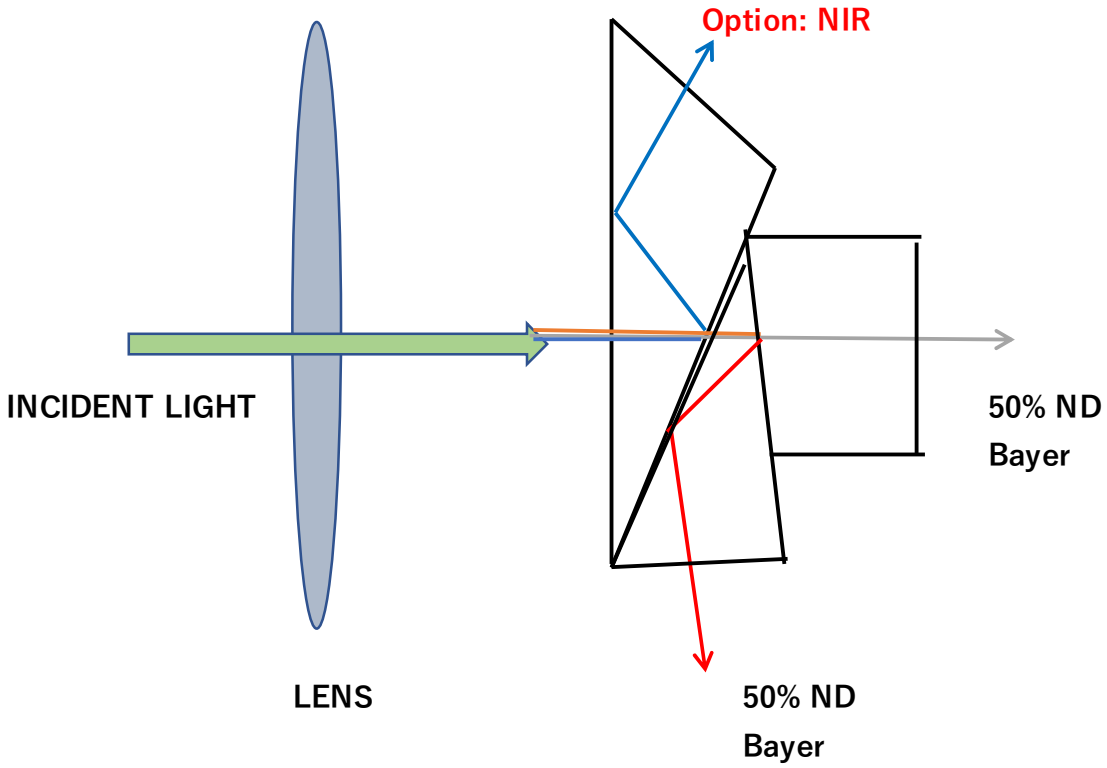

High-Dynamic Range
Below pictures can be obtained at the same time. As the shutter can be controlled of both sensors.

This avoids the saturation area

MODEL 5: Bayer RGB+SWIR

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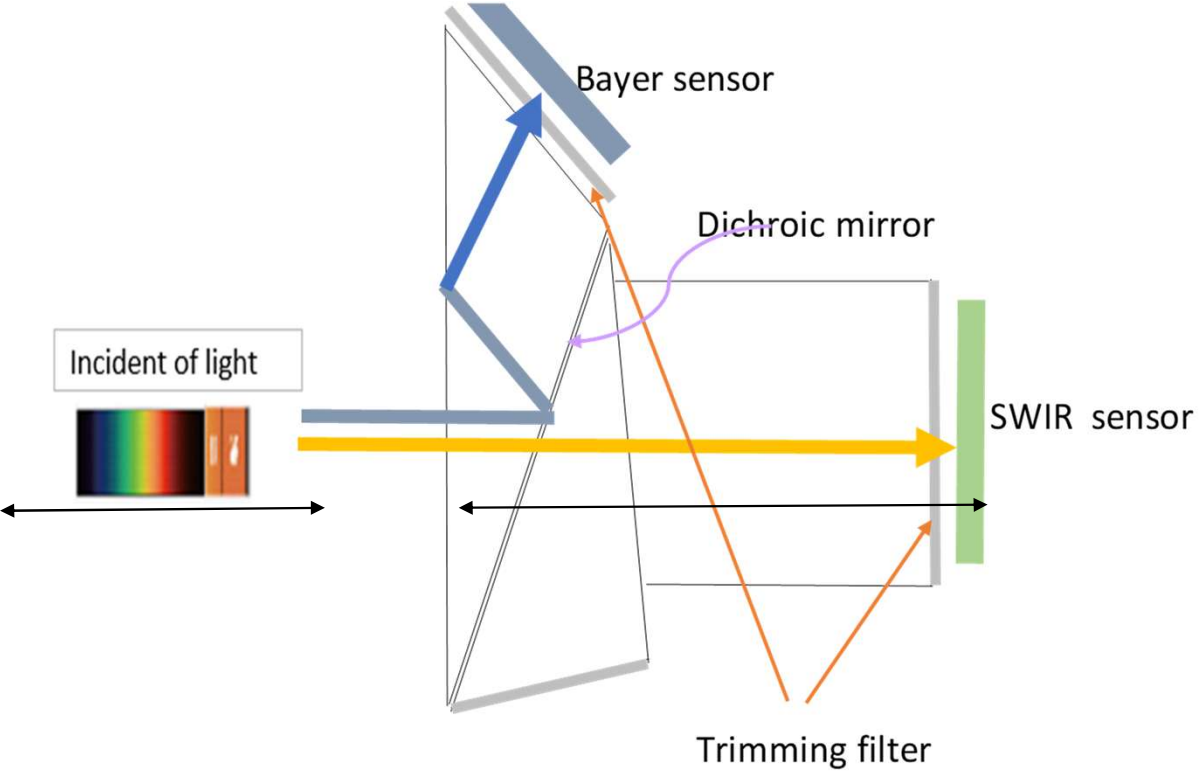

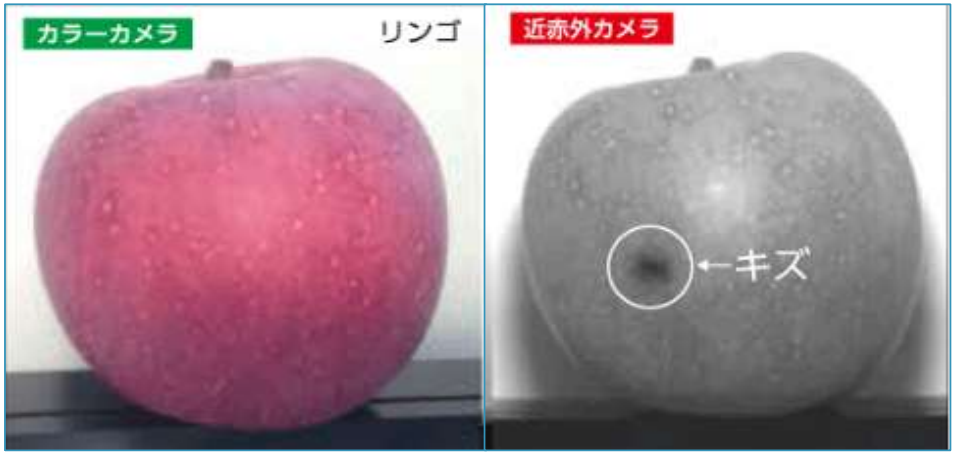

MODEL 6: Dual Focus camera

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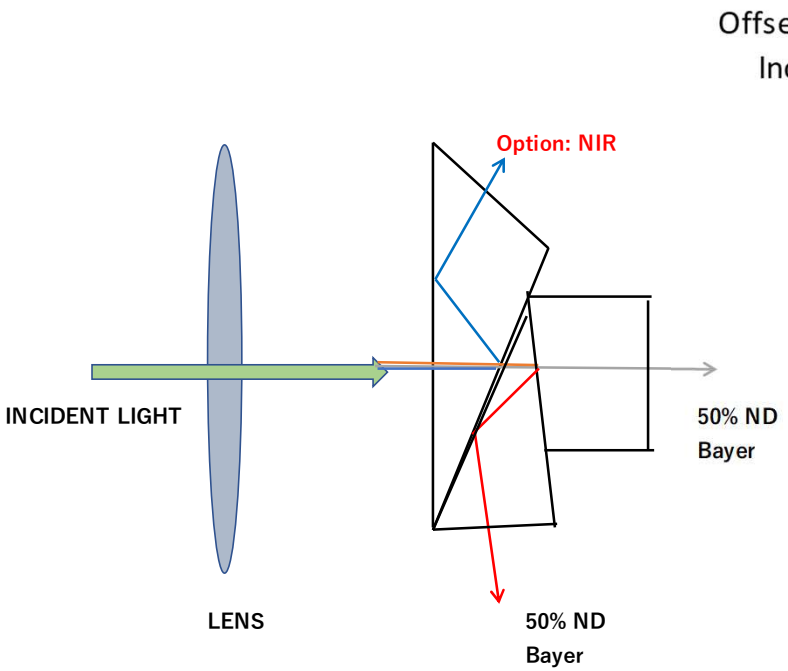
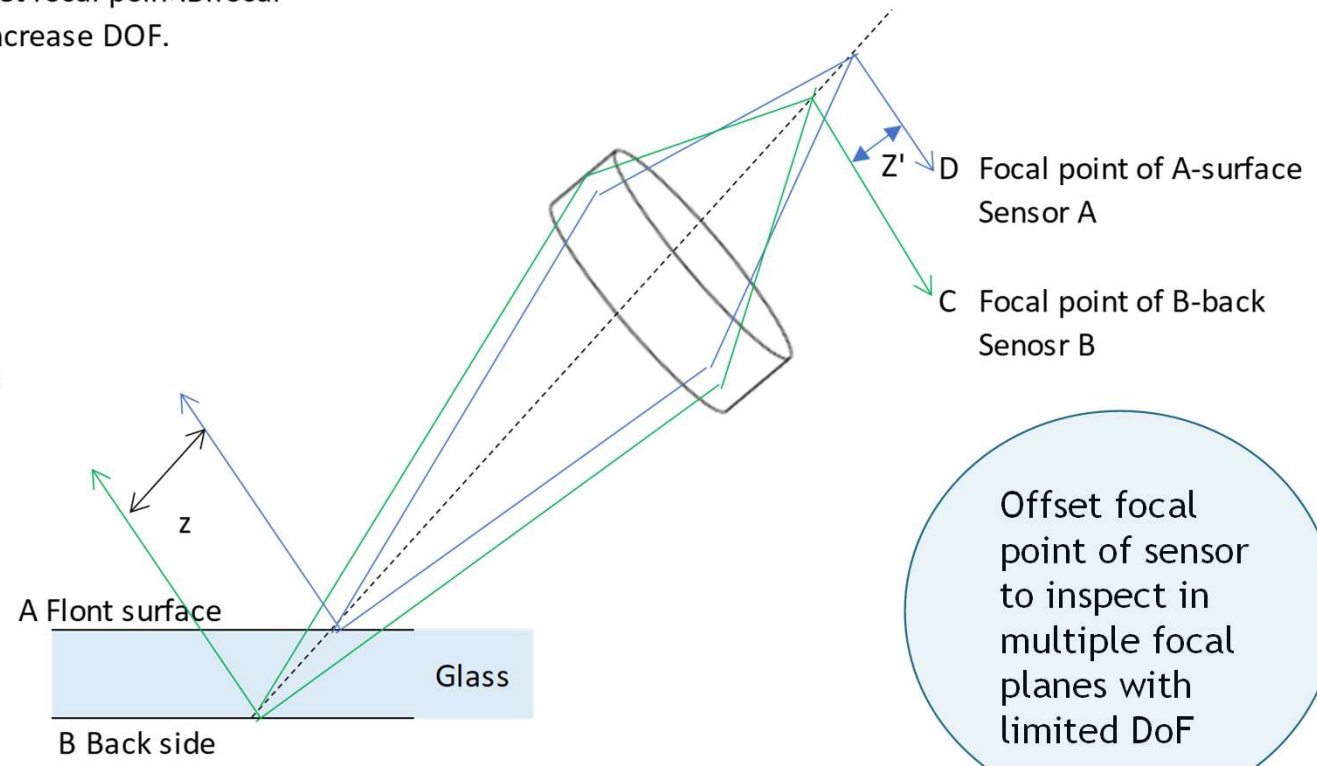


Offset focal point :Bifocal
Increase DOF.



Offset focal point of sensor to inspect in multiple focal planes with limited DoF

MODEL 8: Using two independent shutters

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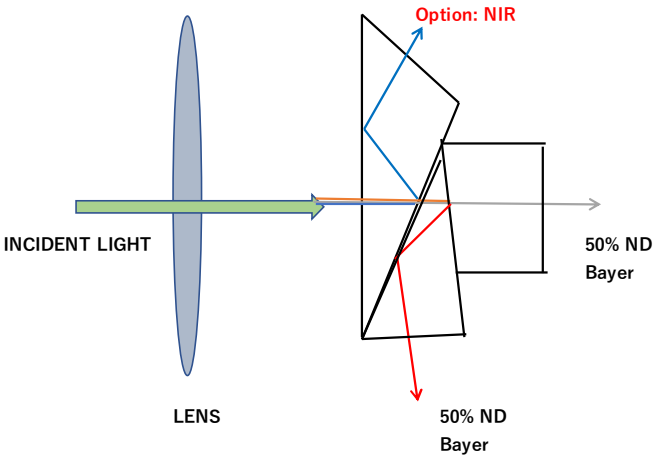
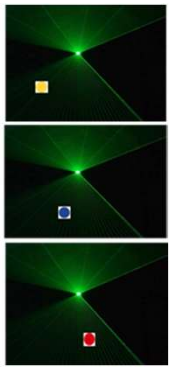
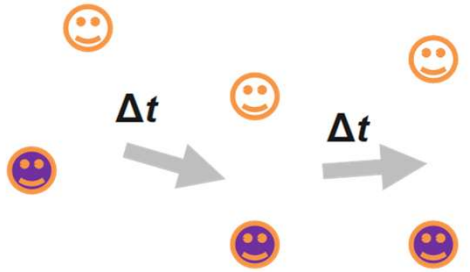


Control the individual sensors as individual cameras and vary the capturing in the time domain



Capturing the individual objects



PIV principle

MODEL 9: Bayer RGB + TOF Area sensor

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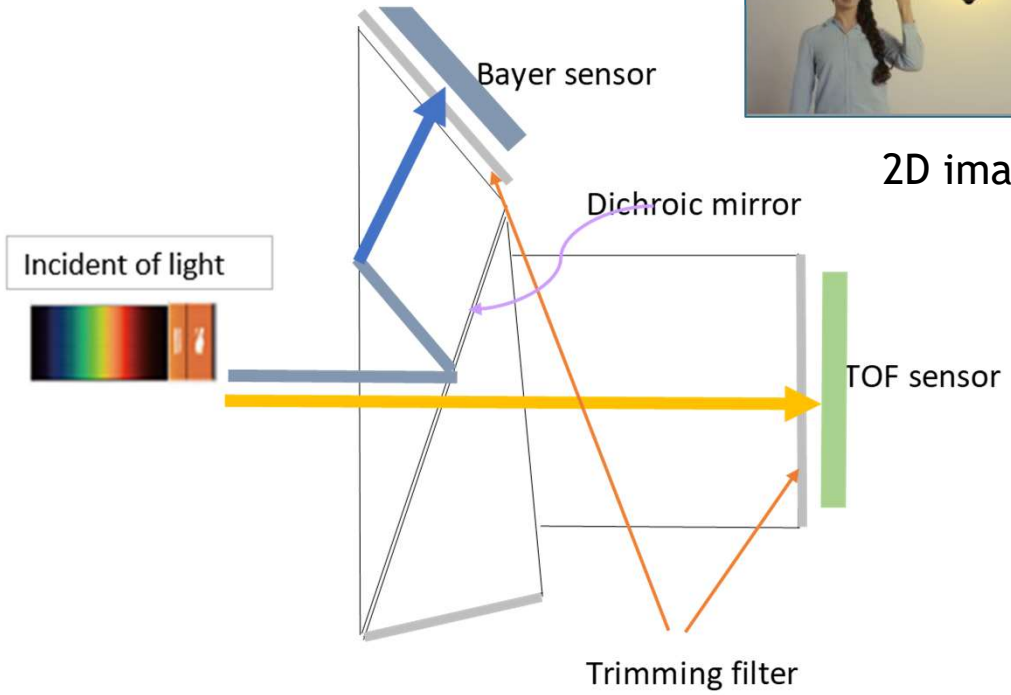
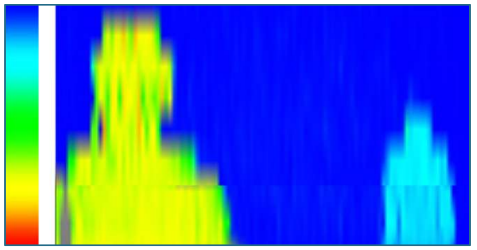


2D image

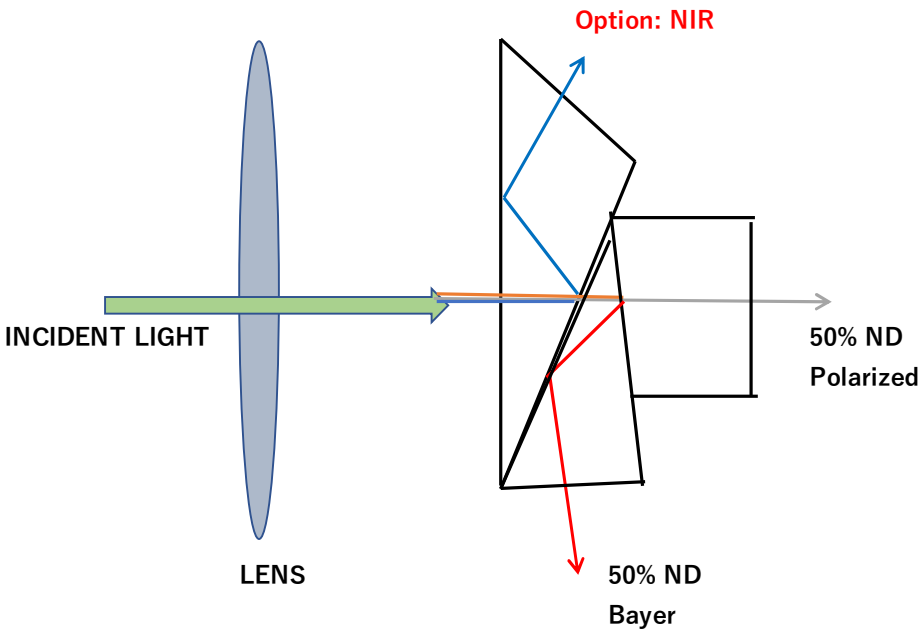
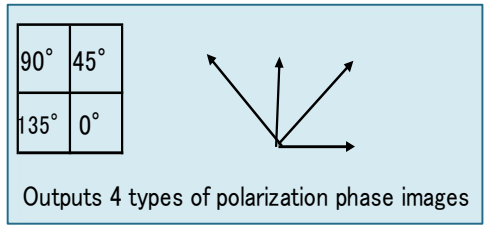
Far



Near

3D image
TOF sensor

Detecting the reflective Aereas in the image.

Model 10 Bayer RGB + Polarized sensor

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