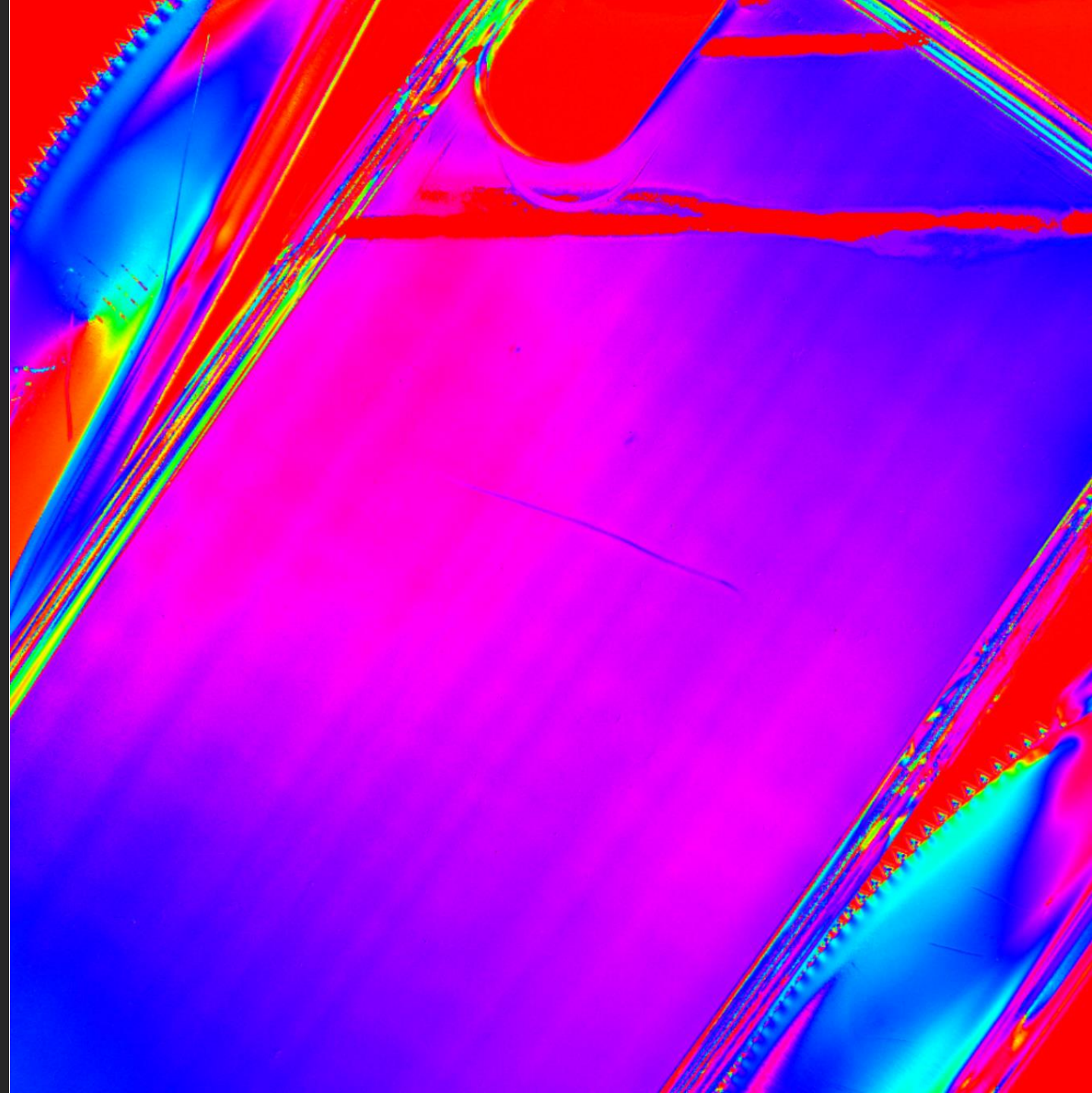




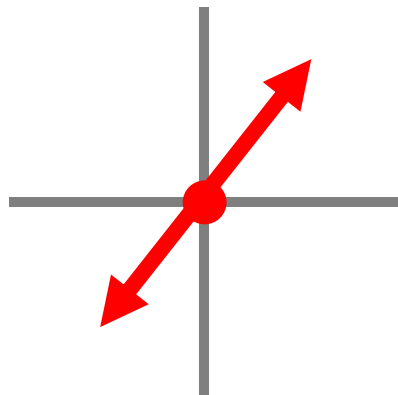
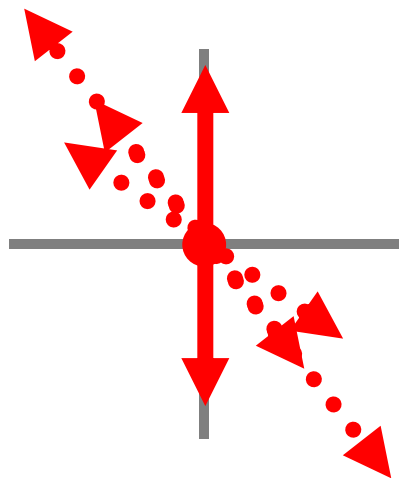
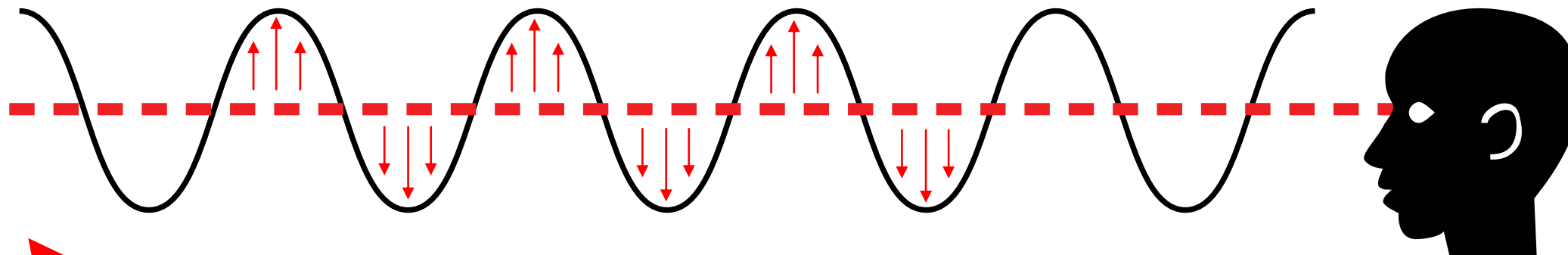
INSPECTION WITH POLARIZATION SENSOR IMAGING THE UNSEEN

*Shanghai Wuling Optics Technology Co.,Ltd.
Greater China Agency*



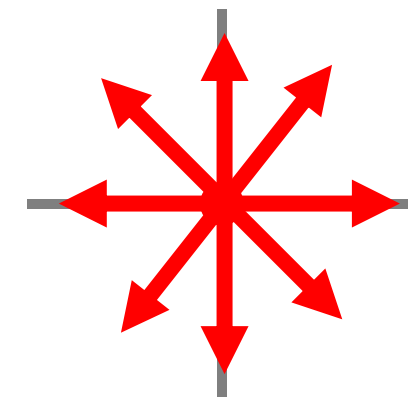


POLARIZED LIGHT, WHAT IS THAT?



Light oscillating at only
one angle is
linearly polarized

Light with
multiple angles is
unpolarized



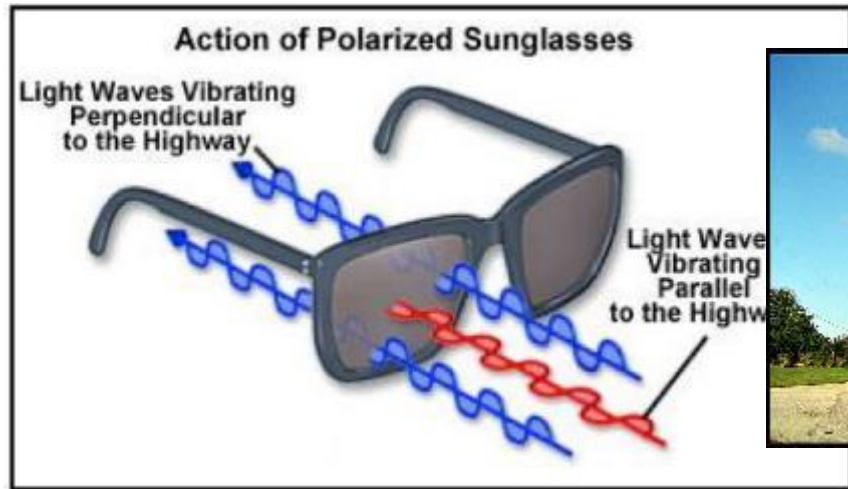
Angle of linear polarization - Angle of the polarized light

Degree of linear polarization - How well the light is polarized



WHY SHOULD I CARE?

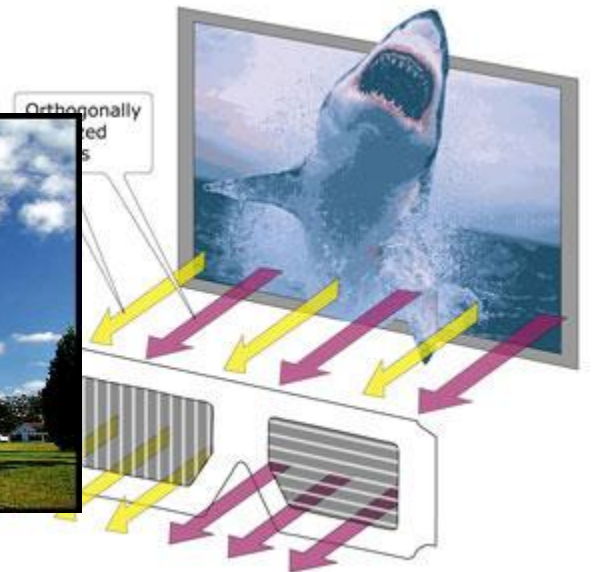
Polarization may be an abstract concept but it exists in everyday life



Sunglasses



Photography

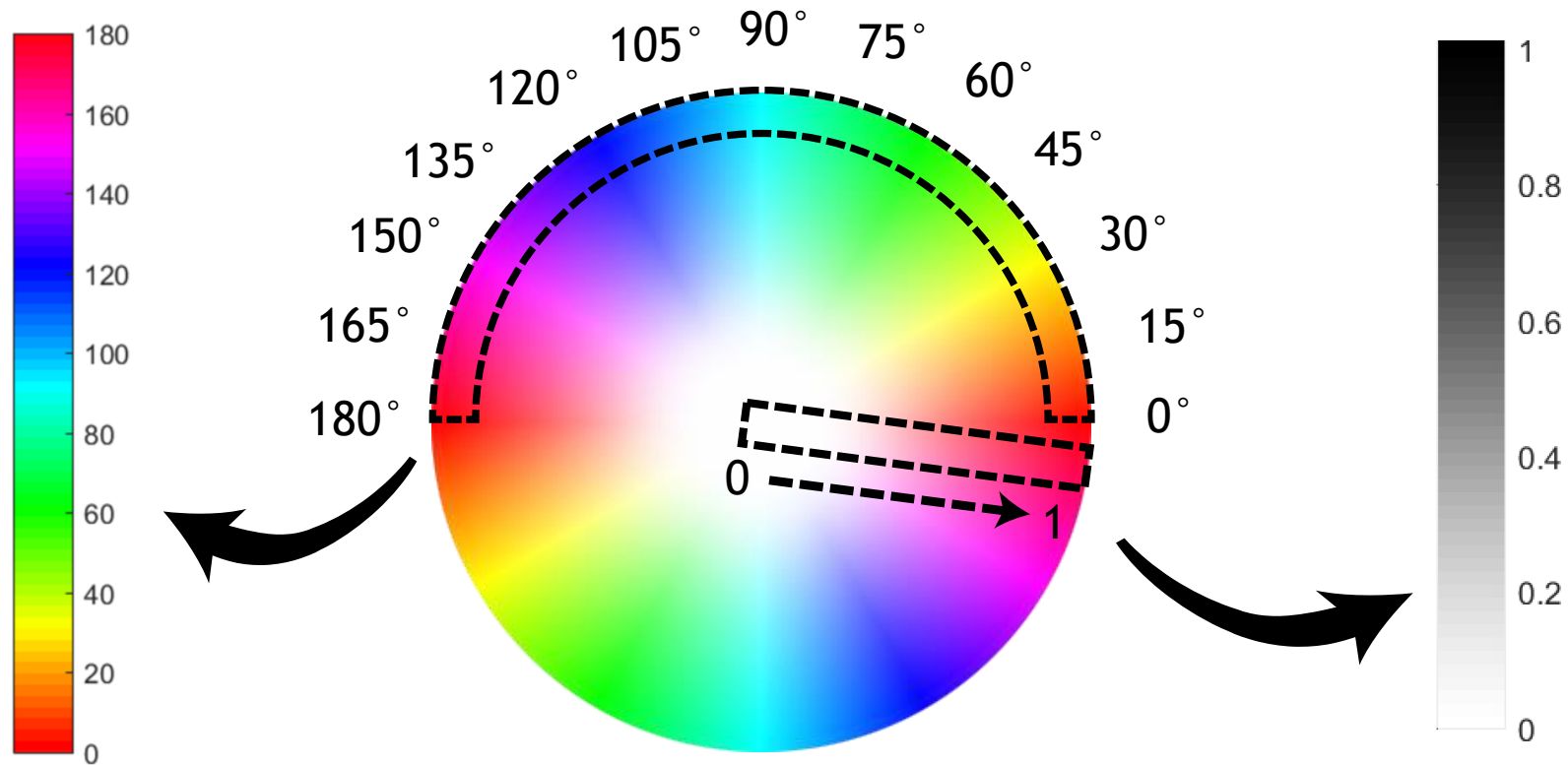


3D Movies



IMAGING THE UNSEEN

All images are taken with Lucid Phoenix Polarization camera and processed using a color wheel to represent polarization information





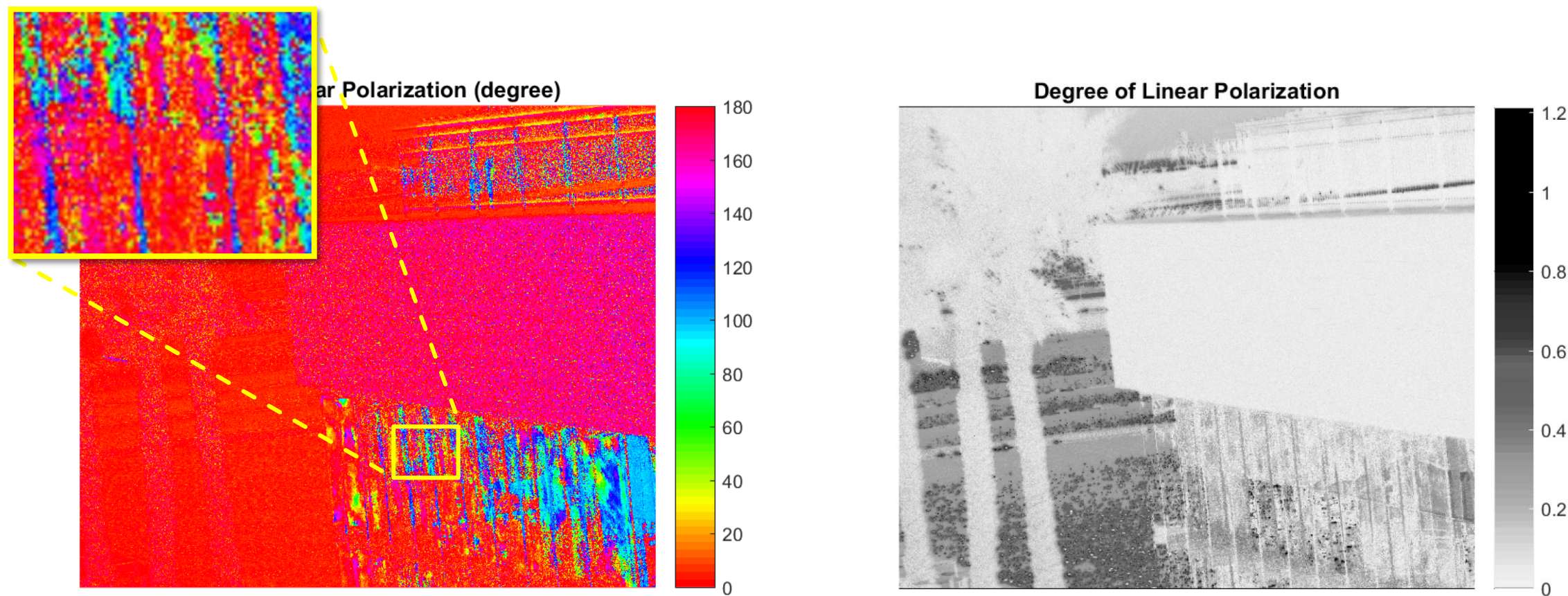
IMAGING THE UNSEEN WITH PHOENIX



Monochrome image of the ocean and part of a building

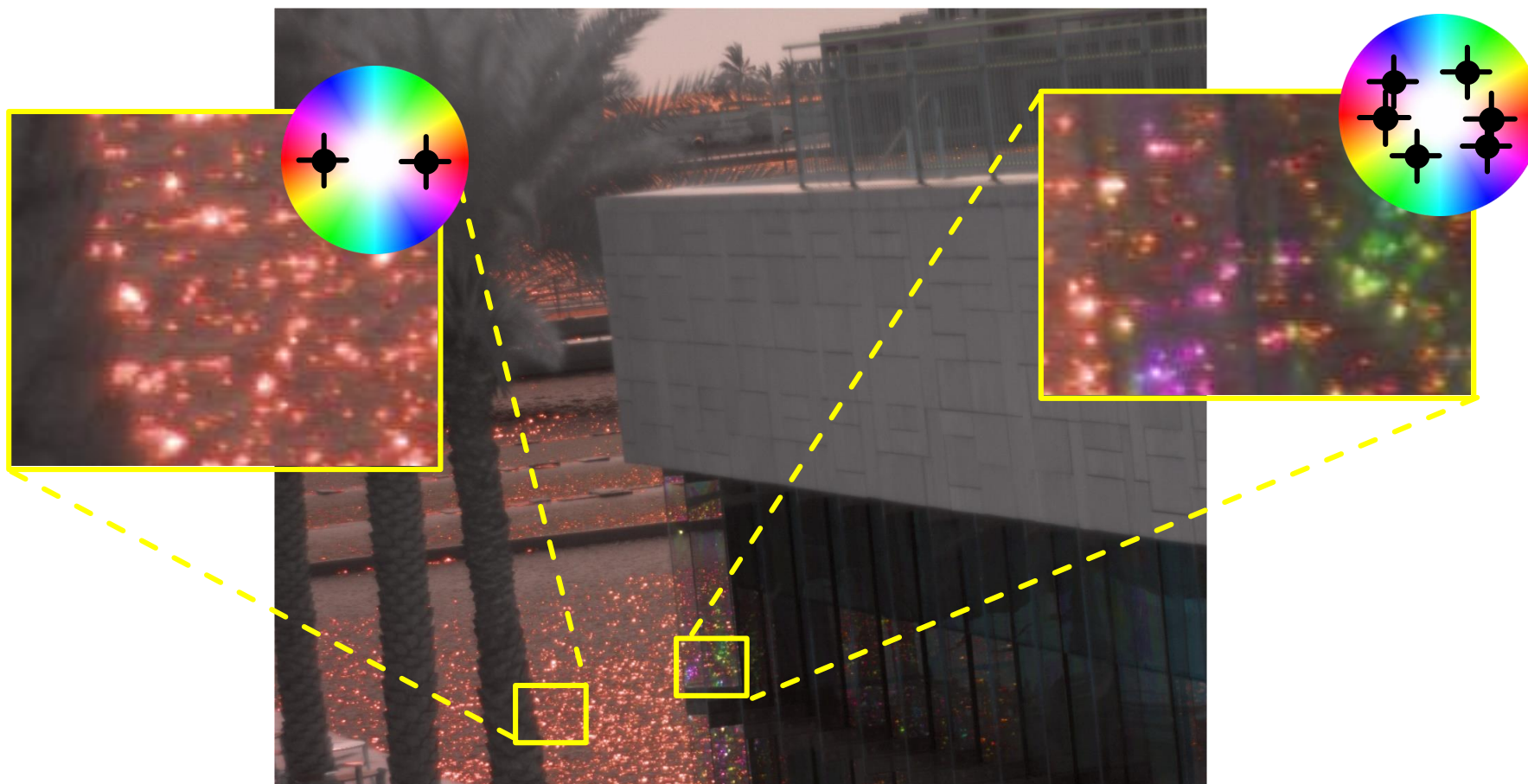


IMAGING THE UNSEEN WITH PHOENIX



Polarization information of the ocean and part of a building

IMAGING THE UNSEEN WITH PHOENIX



Scene of the ocean and part of a building with polarization data overlaid



IMAGING THE UNSEEN WITH PHOENIX



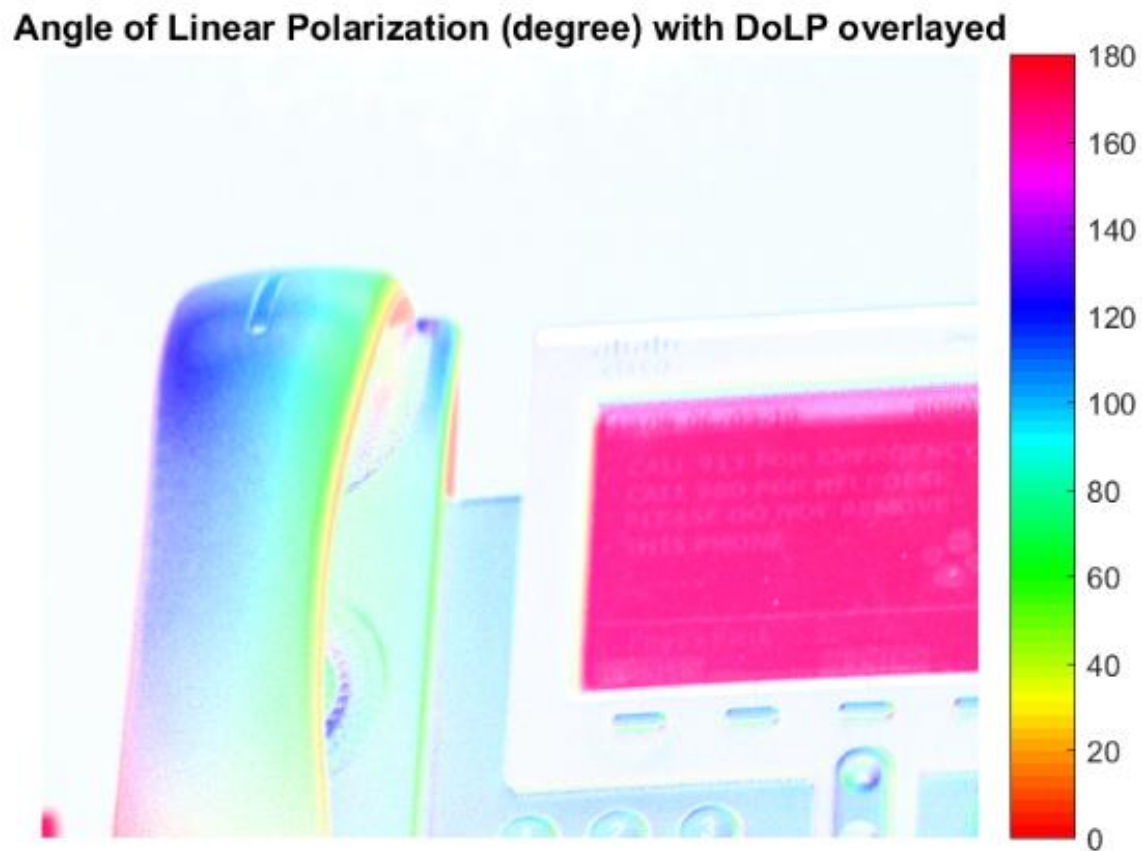
Monochrome image of curved phone handle and flat display screen



Image with polarization information overlaid



IMAGING THE UNSEEN WITH PHOENIX



Angle and degree information can be used to extract surface normal

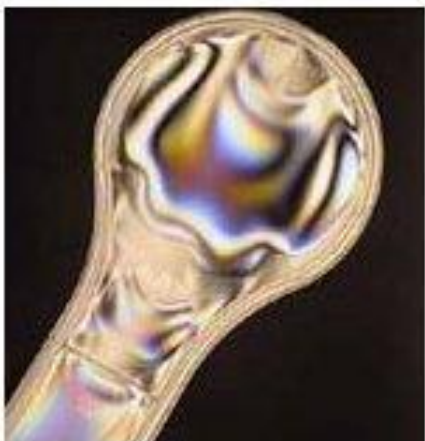


POLARIZATION IN VISION INSPECTION

Challenges in modern day inspection tasks

- Reflective surfaces
- Stress in materials
- Low contrast objects/surfaces

Existing solutions are **bulky and expensive** (\$6000+) or requires more mechanical parts (rotating filters).



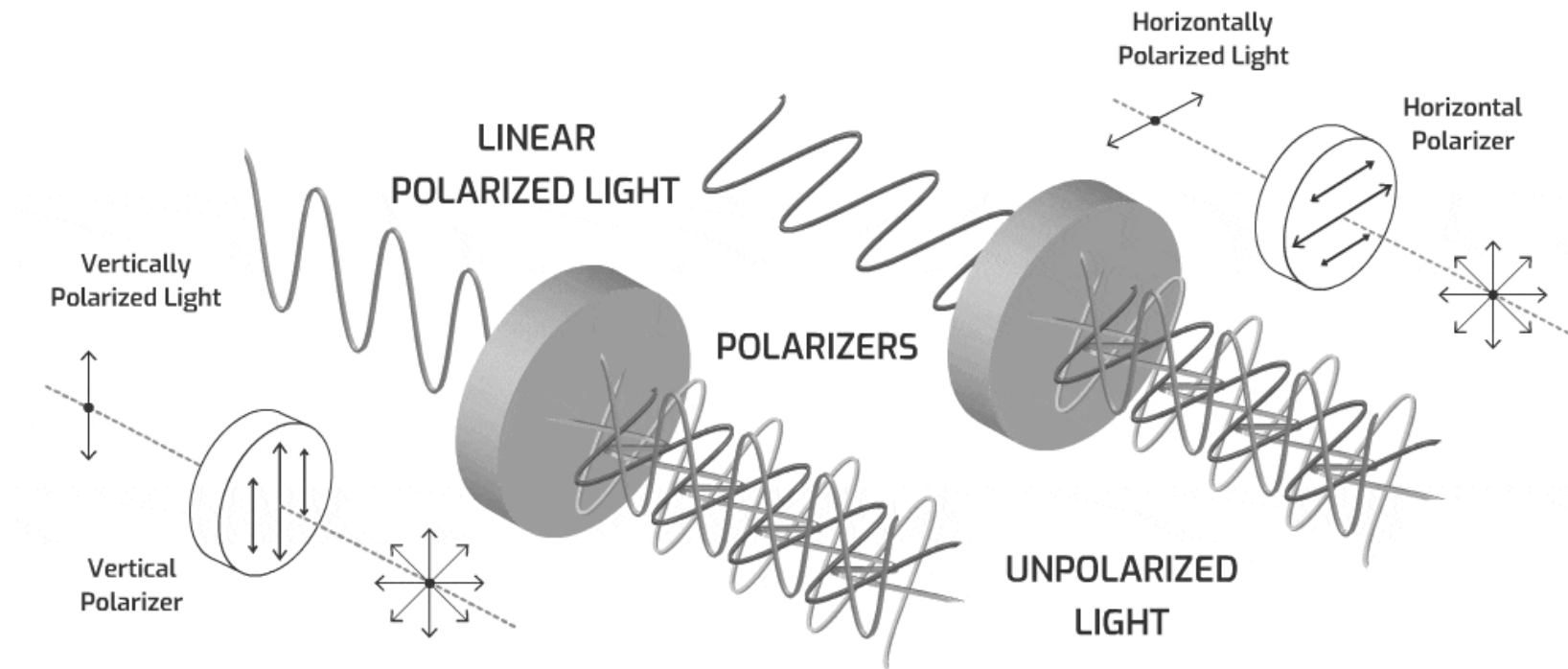
POTENTIAL APPLICATIONS USING POLARIZATION

- Object inspection
 - Defects and stress
 - Reflective surface inspection
- Microscopy
- Low contrast surfaces like black rubber
- Marine applications
- Others such as dehazing
- Object detection and segmentation

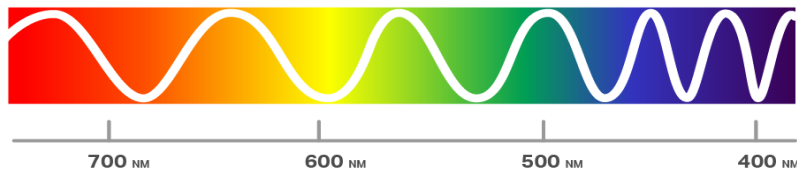




HOW LIGHT BECOMES POLARIZED



Color = Wavelength



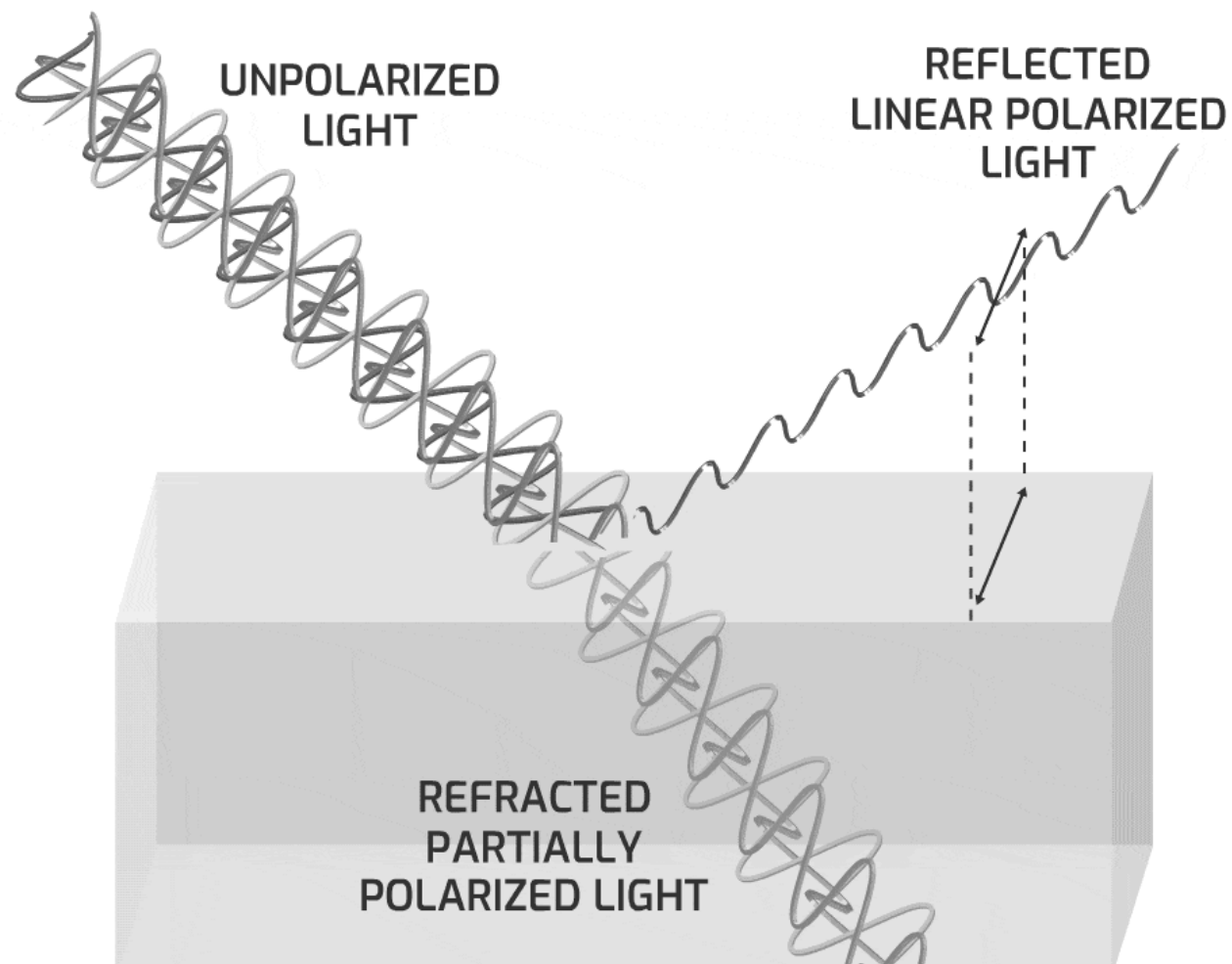
Brightness = Amplitude



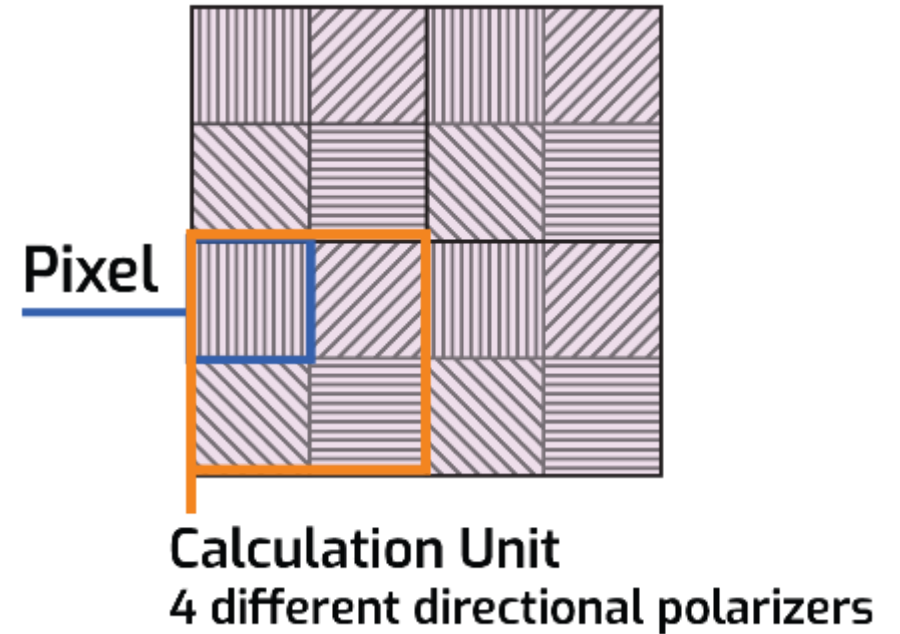
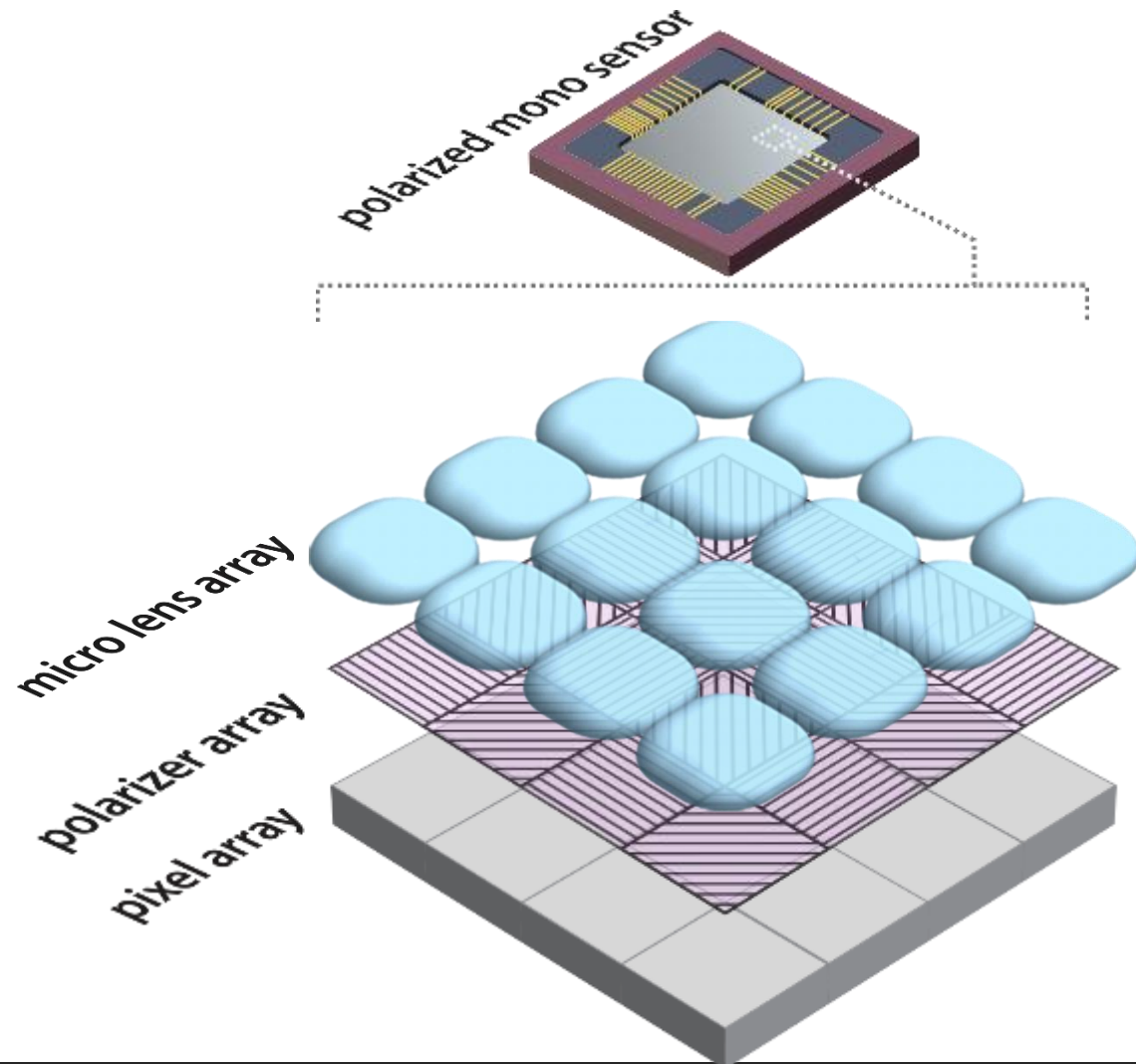


HOW LIGHT BECOMES POLARIZED

Light can also be polarized through reflection or refraction

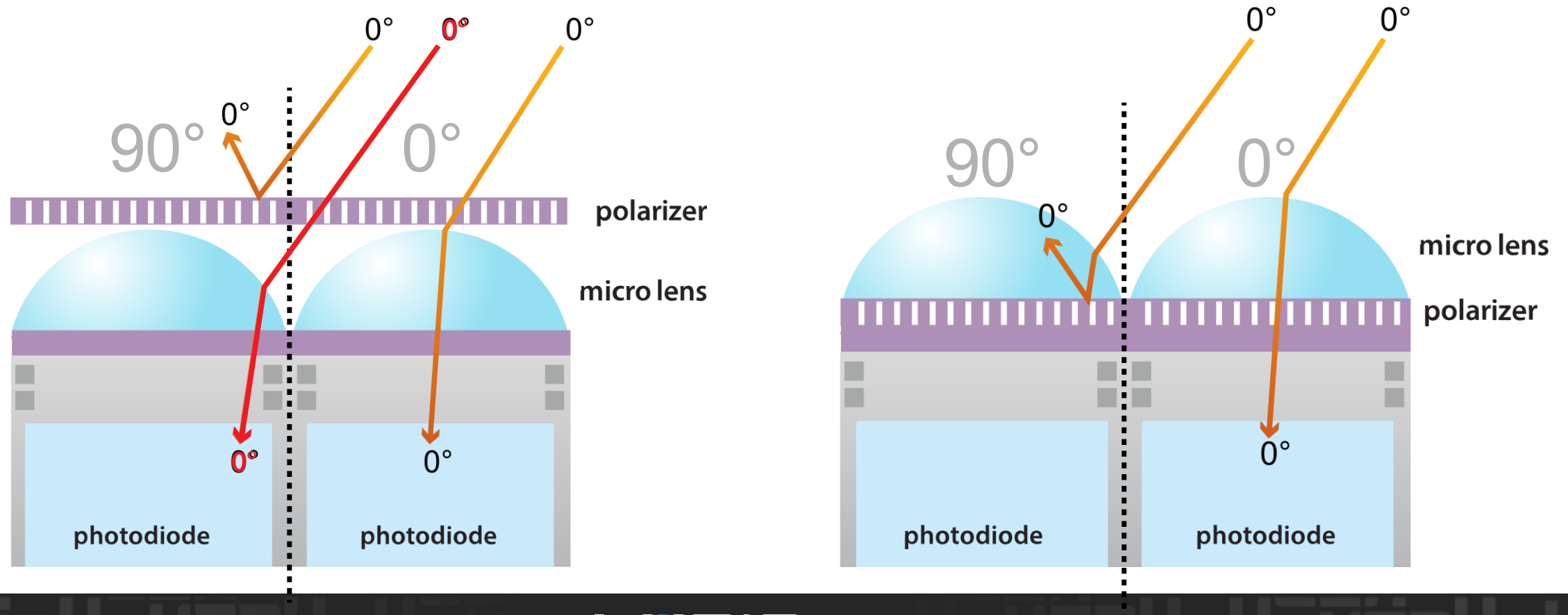


SONY IMX250MZR POLARIZATION TECHNOLOGY



SONY IMX250MZR POLARIZATION TECHNOLOGY

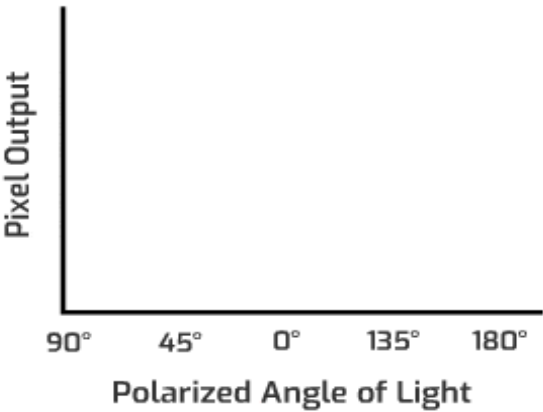
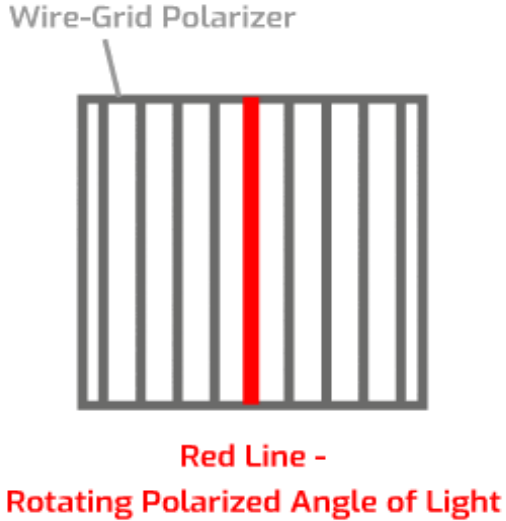
This design makes the sensor more sensitive compared to other polarization sensors that places the wire-grids above the micro lens array





SONY IMX250MZR POLARIZATION TECHNOLOGY

Resolution	2448 x 2048
Pixel size	3.45μm
Sensor format	2/3"
PHX050S-P Frame rate	24fps
Extinction ratio	~24 dB



WHAT CAN YOU DO WITH POLARIZATION PHOENIX?

OBJECT IDENTIFICATION



A truck parked in the shade

Polarization image clearly identifies the truck



WHAT CAN YOU DO WITH POLARIZATION PHOENIX?

Float on the ocean surface





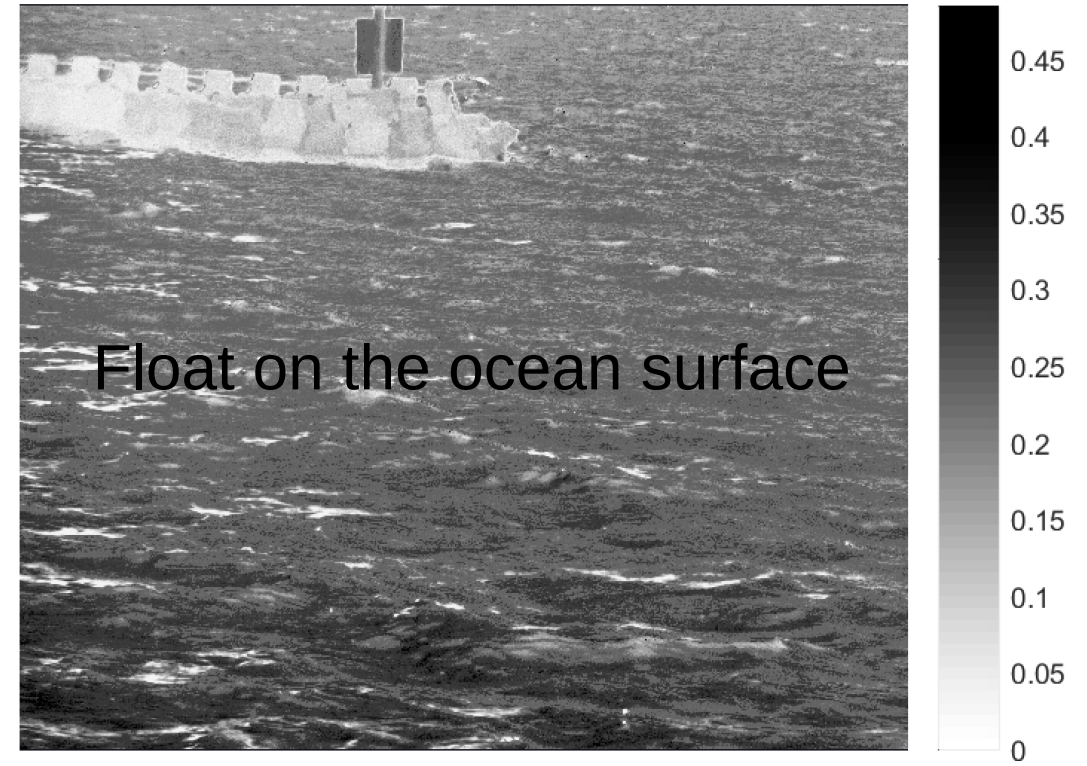
WHAT CAN YOU DO WITH POLARIZATION PHOENIX?

OBJECT SEGMENTATION

Angle of Linear Polarization (degree)



Degree of Linear Polarization



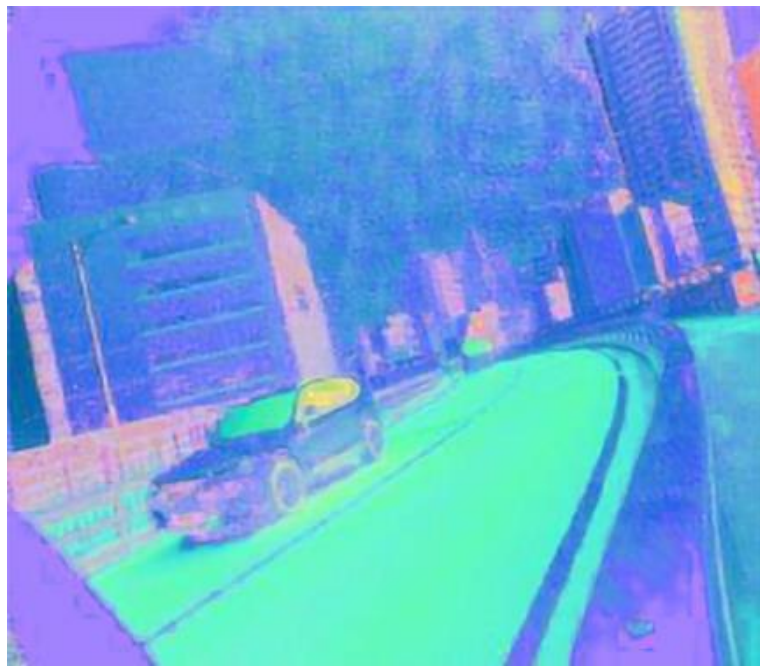
Angle of polarization image clearly identifies the float

WHAT CAN YOU DO WITH POLARIZATION PHOENIX?

Surface (Road) Detection



WHAT CAN YOU DO WITH POLARIZATION PHOENIX?



Angle of polarization identifies the road

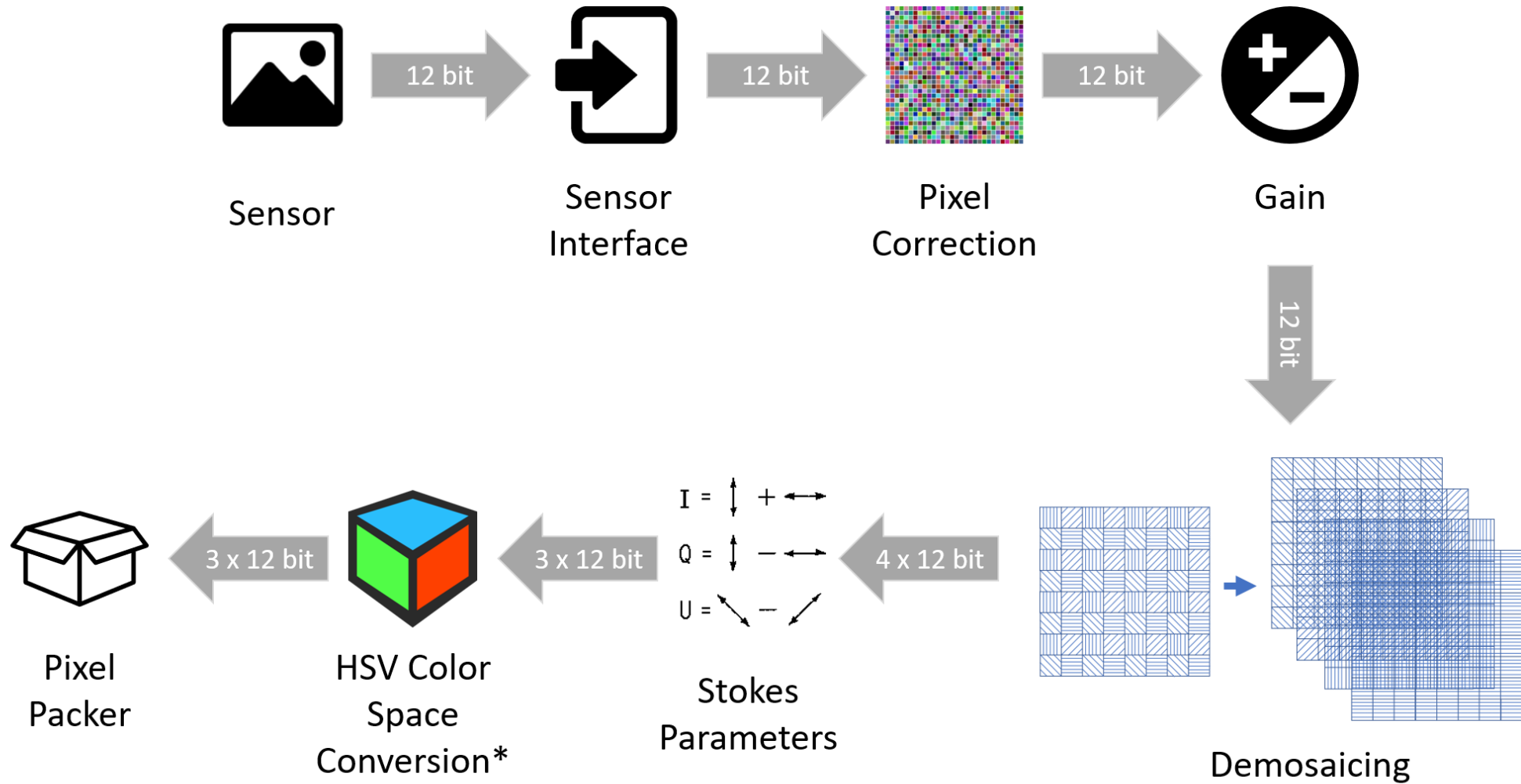


Thresholding can be used to isolate flat surface

Surface Segmentation



POLARIZATION PHOENIX IMAGE PROCESSING PIPELINE



* Optional

PHOENIX: INDUSTRY'S SMALLEST GIGE POE CAMERA



NF MOUNT

NF mounting and lens options provide even smaller footprint, up to 40% less space compared to c-mount. Supports up to 2/3" sensor sizes.



IX CONNECTOR

70% less space than RJ45 sockets. High EMC immunity and snap-in locking



TRANSFORMABLE

The camera can be mounted in various configurations such as flat or right angle.



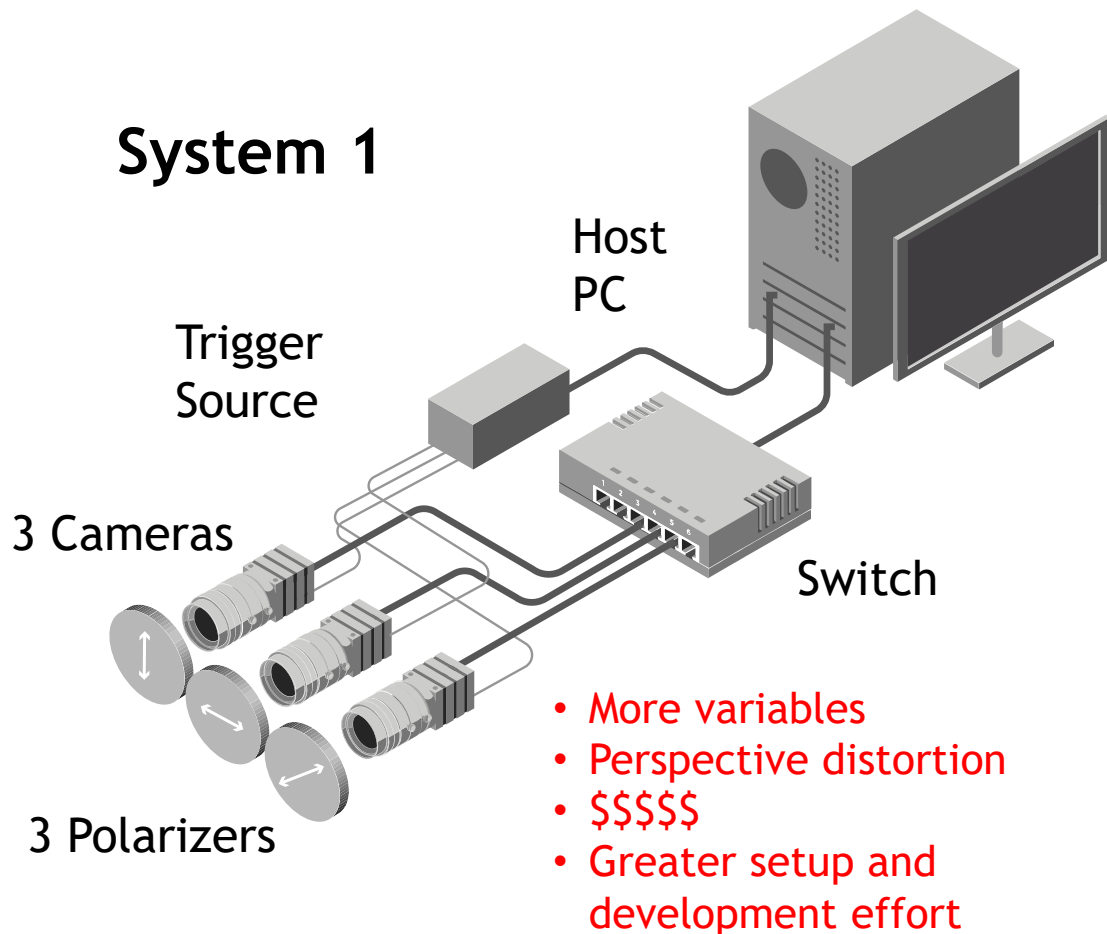
GiGE
VISION

GEN< i >CAM

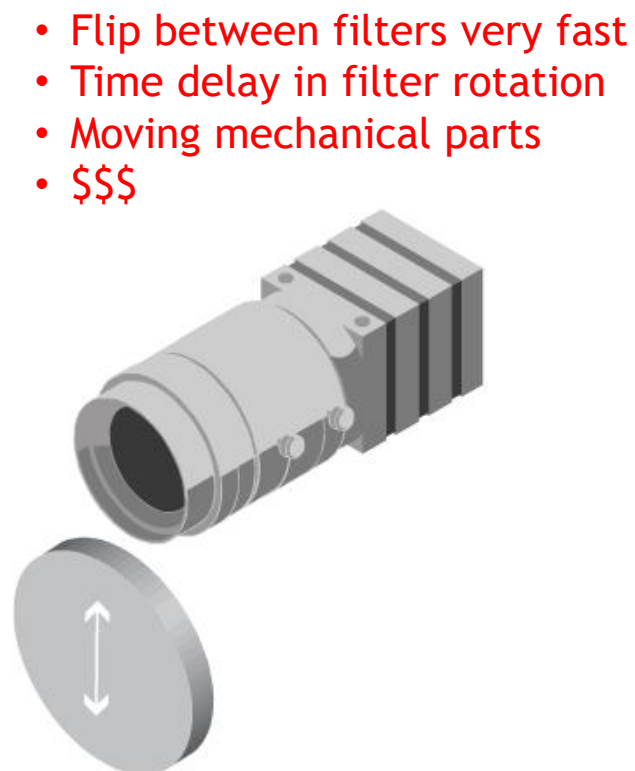


EXISTING POLARIZATION SOLUTIONS

System 1



System 2



System 3

- No moving part, simple setup
- Complete linear polarization data with one camera
- Overall system cost-saving
- Low effort for development



SPECIFICATION

SENSOR PROPERTIES

Sensor Model	Sony IMX250MZR CMOS Polarized – four different directional polarizing filters (0°, 90°, 45°, and 135°)
Shutter Type	Global
Sensor Size	11.0 mm (Type 2/3')
Resolution	2448 x 2048 px, 5.0 MP
Pixel Size	3.45 µm (H) x 3.45 µm (V)
Framerate	24 FPS @ 5.0 MP

PHYSICAL PROPERTIES

Dimensions	24 x 24 x 27.35 mm
Lens Mount	C, NF-Mount
Weight	30 g

INTERFACE AND POWER INFORMATION

Digital Interface	1000BASE-T RJ45, PoE
GPIO Interface	8 pin JST connector
Opto-Isolated I/O Ports	1 input, 1 output
Non-Isolated I/O Ports	2 bi-directional
Power Requirement	PoE (IEEE 802.3af), or 12-24 VDC external
Power Consumption	3.1W via PoE, 2.5W when powered externally

IMAGING PROPERTIES

Image Buffer	128 MB
Image Processing	Gain
Pixel Formats	Mono8/10/12/16
Image Modes	Horizontal and vertical binning, decimation, ROI, horizontal and vertical flip
ADC	12 bit
Gain Range	0 dB to 48 dB analog and digital
Exposure Time	30 µs to 10 s

CAMERA FEATURES

User Sets	1 default and 2 custom user set
File System Size	16 MB
Chunk Data	Timestamp, frame counter, offset X/Y, width/height, exposure time, gain, black level, line status, sequencer set
Event Data	Acquisition start/end, exposure start/end, line rise/fall, error
Counter & Timer	2 counters and 2 timers
Sequencer	Exposure time, gain
Synchronization	Software trigger, hardware trigger, PTP (IEEE 1588)

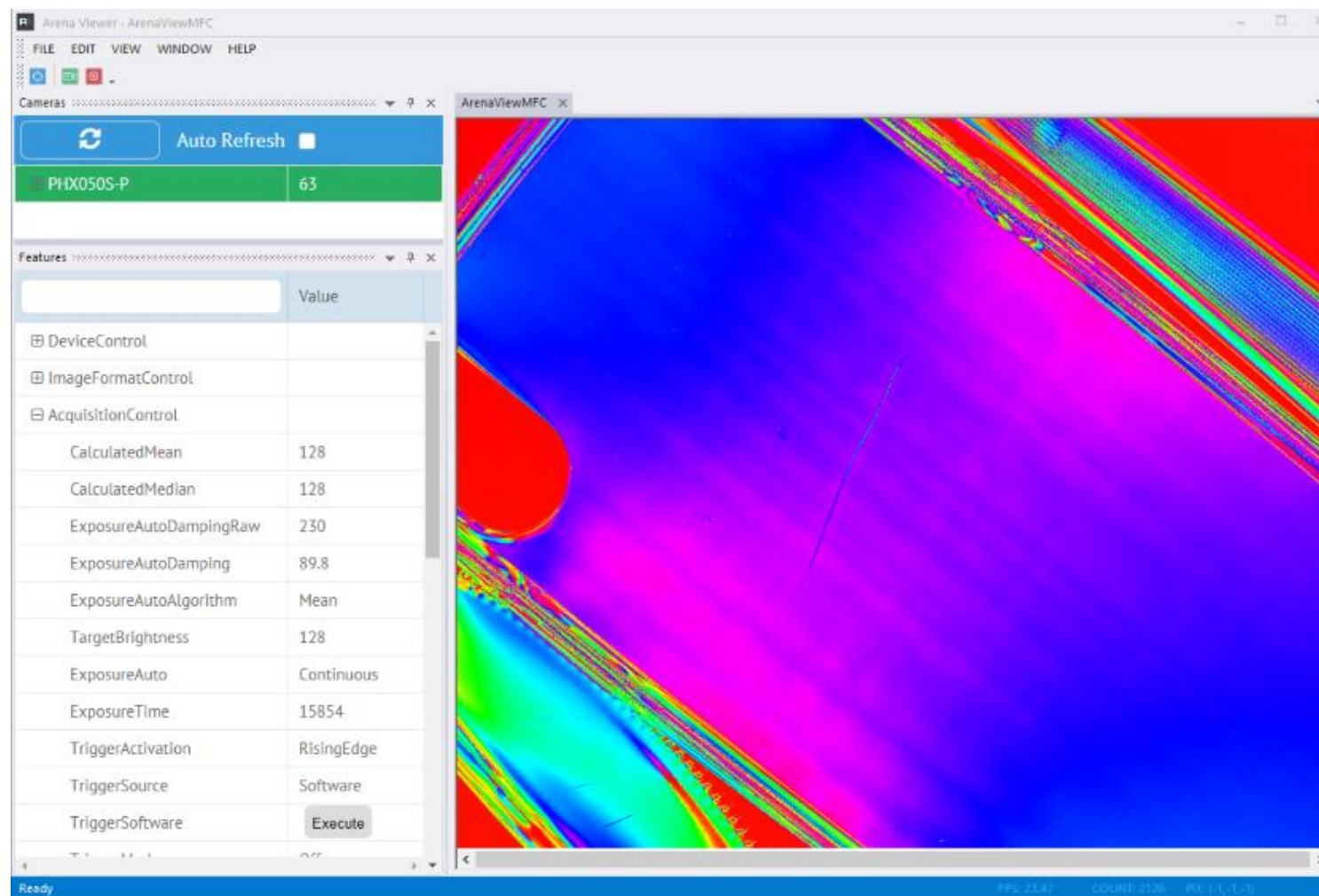
STANDARDS AND CERTIFICATIONS

Standard	GigE Vision v2.0
Compliance	CE, FCC, RoHS, REACH, WEEE
Storage Temperature	-30 to 60°C
Operating Temperature	-10 to 55°C
Humidity	Operating: 20% ~ 80%, relative, non-condensing
Warranty	3 year

GigE
VISION

GEN< i >CAM

ARENAVIEW - POLARIZATION DISPLAY



CONTACT



<http://www.thinklucid.com>



<http://www.wulingoptics.com>

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