SONY

Polarization Image Sensor

IMX250MZR / MYR
IMX264MZR / MYR : Diagonal 11.1 mm (Type 2/3) Approx. 5.07M-Effective Pixel Monochrome/Color Polarization CMOS Image Sensor

IMX253MZR / MYR : Diagonal 17.6 mm (Type 1.1) Approx. 12.37M-Effective Pixel Monochrome/Color Polarization CMOS Image Sensor

Characteristic

- Four-Directional Polarizer formed on chip
- Global shutter function
- High frame rate
- ROI mode, Trigger mode

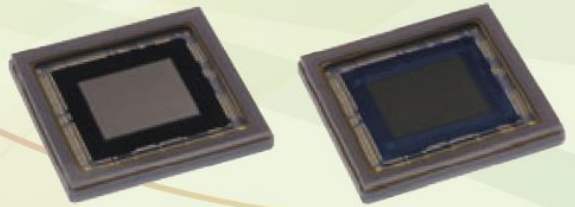


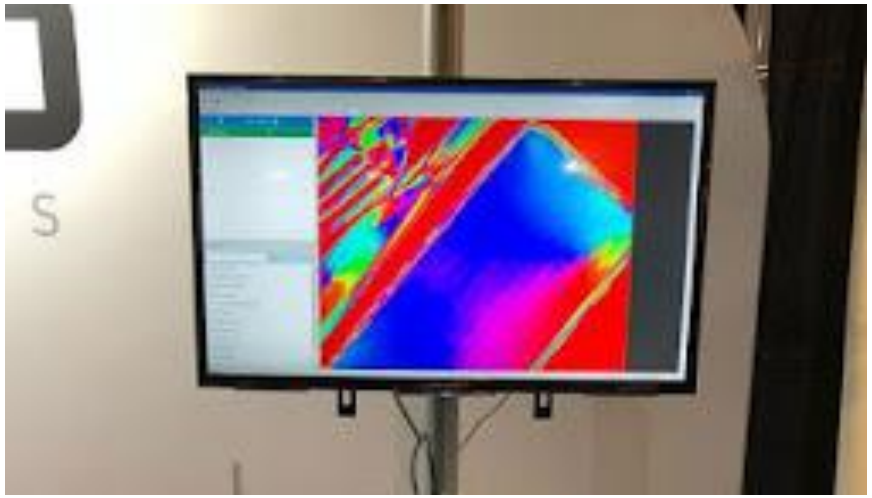
Photo: IMX250MZR / MYR

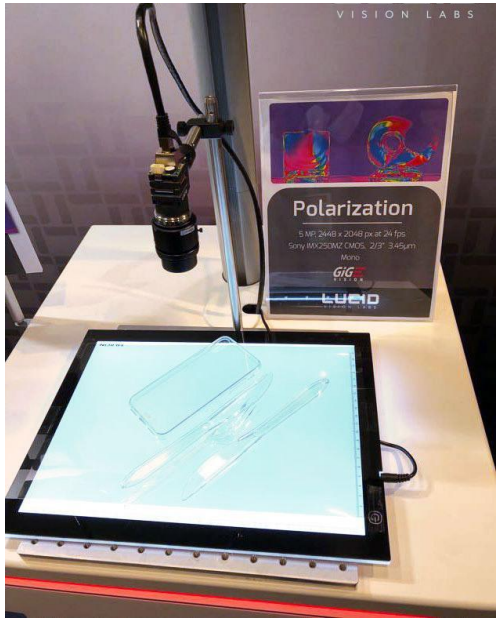
Polarsens

Polarsens is a CMOS Image Sensor pixel technology that has several different angle polarizer formed on chip during the semiconductor process allowing highly accurate alignment with pixel.

*Polarsens and Polarsens are trademarks of Sony Corporation.

In **2018**, Sony released its first CMOS- based polarization imaging sensors, which integrated **patterned wire grid polarizers on-chip onto the pixels.** Nowadays, the Sony IMX250MZR/MYR, IMX253MZR/MYR and IMX264MZR/MYR sensors are commonly available in various electronics packages from several vendors, **with options for monochrome and RGB color,** and a range of detector formats and read-out speeds.

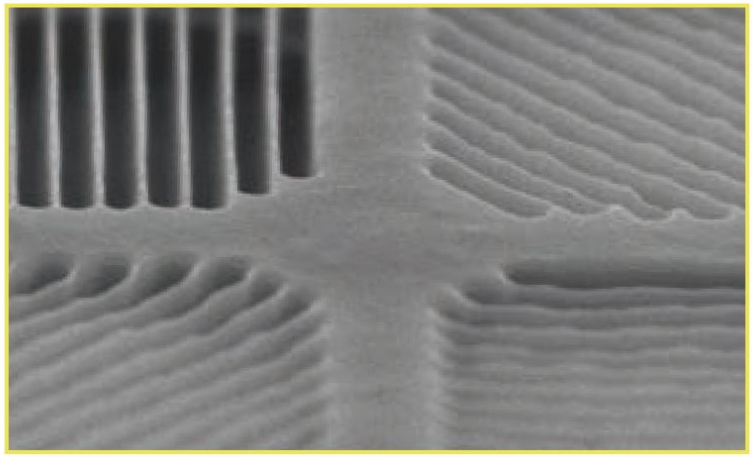




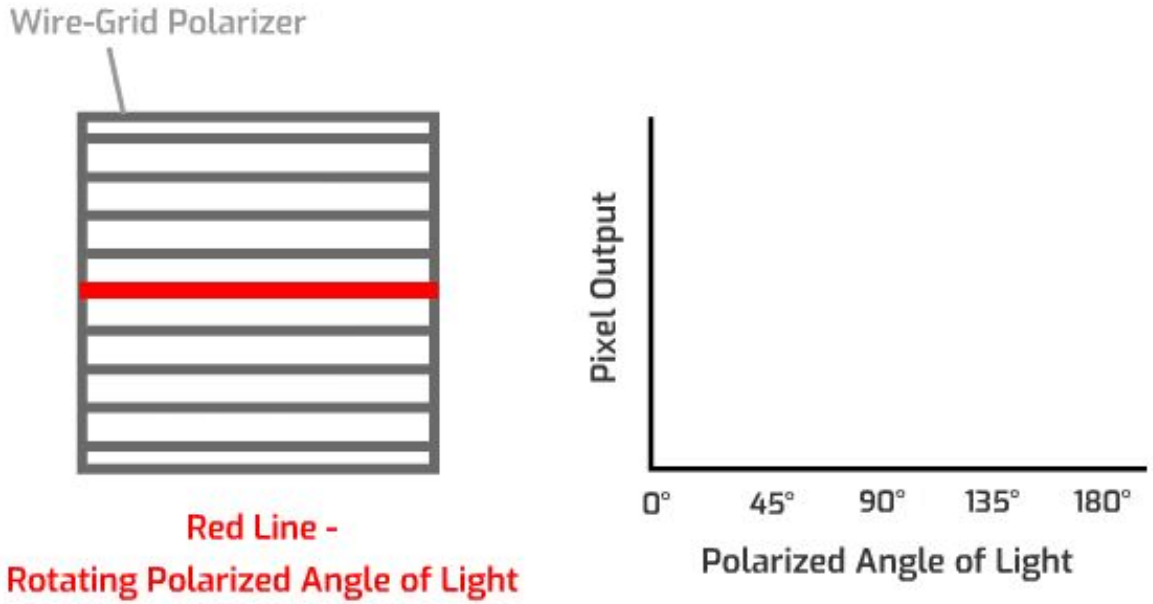
Wire grid polarization is the principle behind Sony's Polarized CMOS sensors

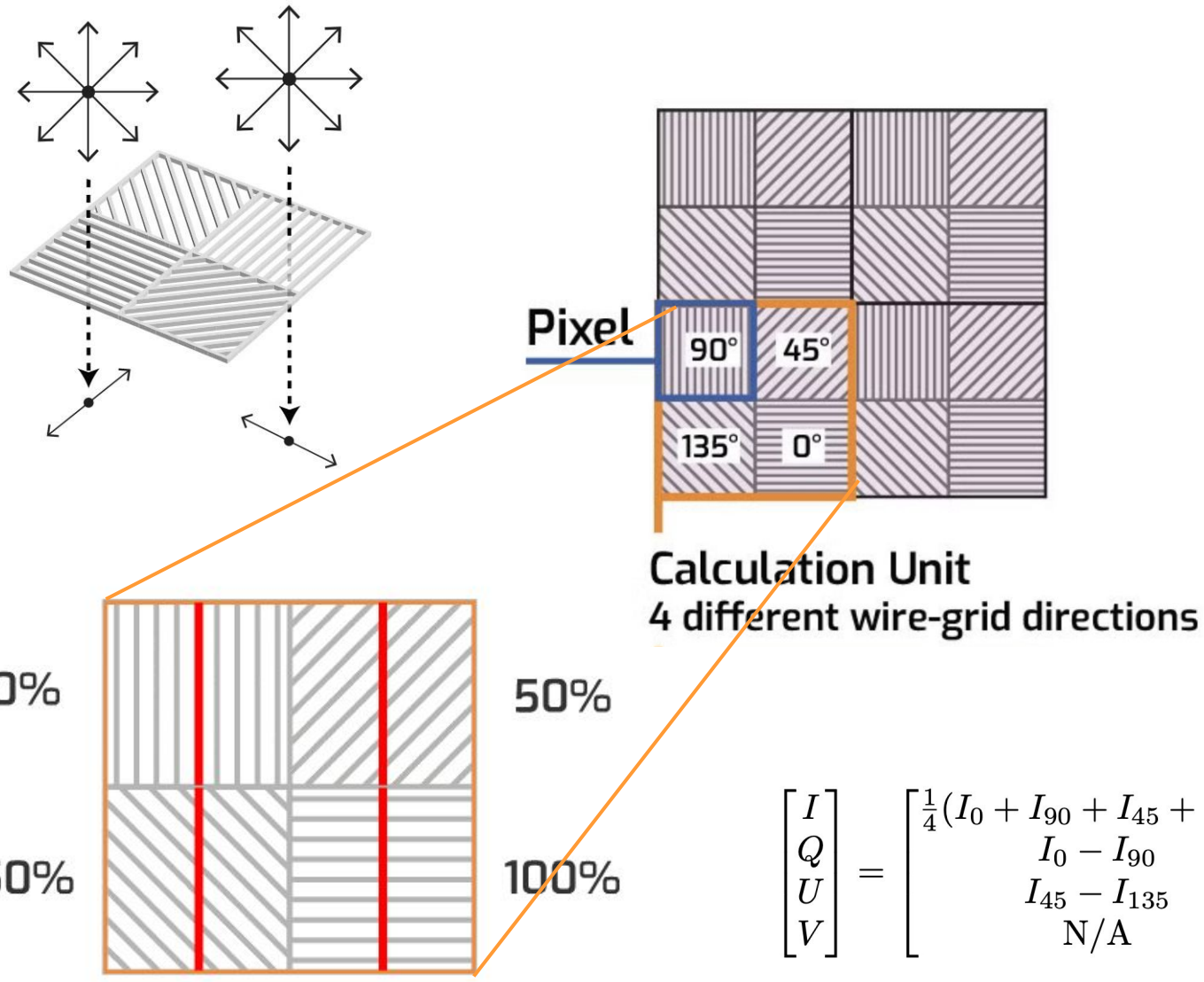
Principle: a wire grid polarizer consists of a fine grid of closely spaced parallel metal wires on a substrate.

Polarization interaction: When light hits the grid, the electric field component that is parallel to the wires excite electrons in the wires, causing them to oscillate and absorb the energy of that polarization. Polarized parallel light is reflected and adsorbed by the wires while perpendicular light passes through.



Polarizer image
Source: Sony, IEDM2016, Lecture number 8.7



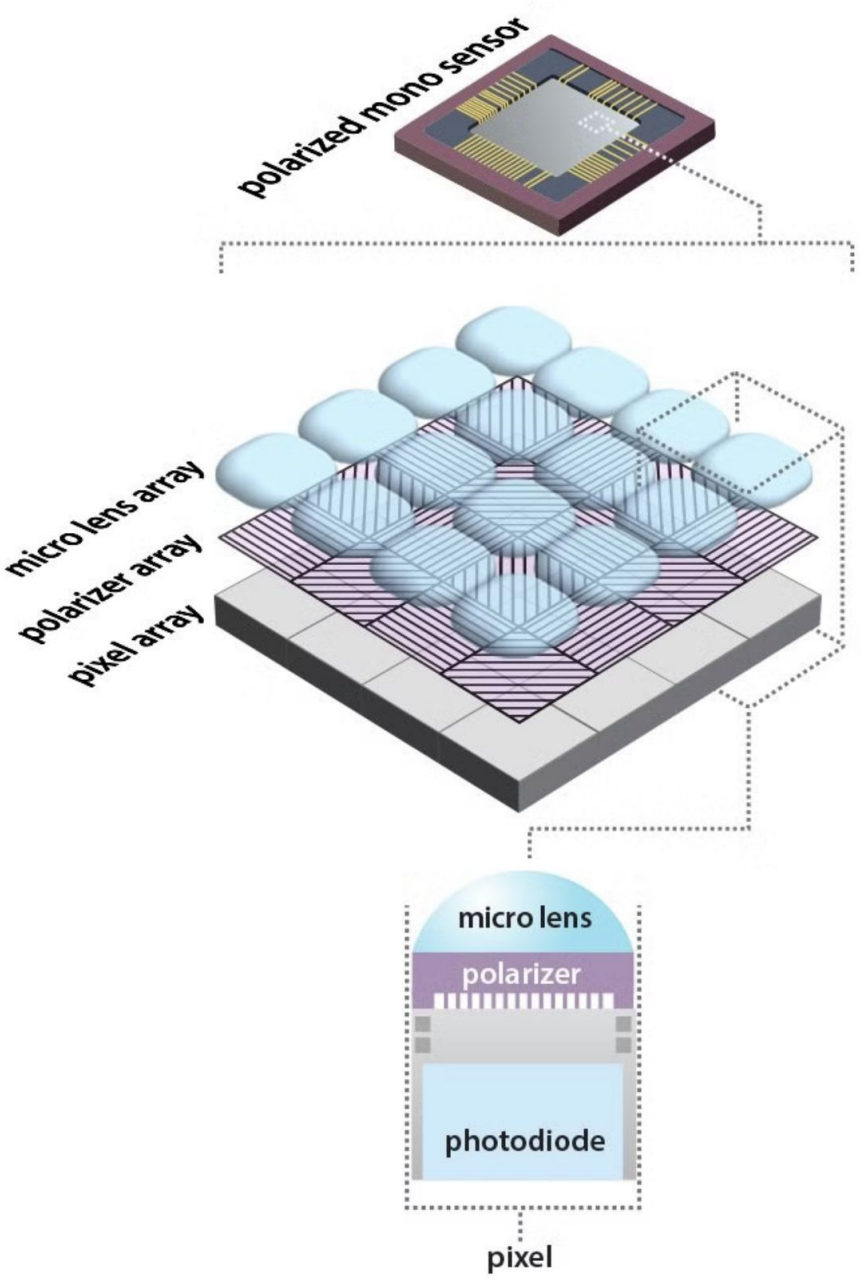


The polarizer array is comprised of four different angled polarizers (90°, 45°, 135° and 0°) which are placed on **3.45 µm pixel**. **Every block of four pixels makes up a calculation unit.**

The relationship between the different directional polarizers in this innovative 4-pixel block design allows **the calculation of both the degree and direction of polarization.**

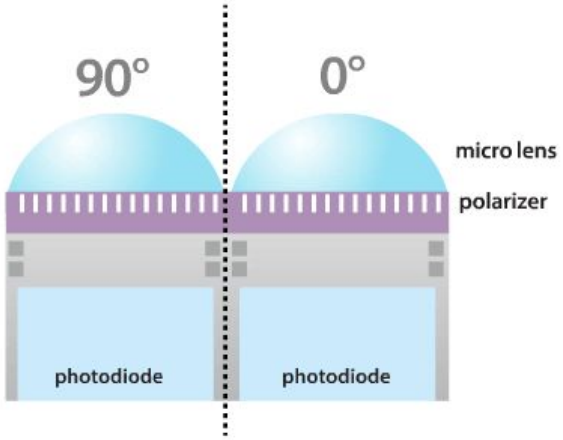
$$\begin{bmatrix} I \\ Q \\ U \\ V \end{bmatrix} = \begin{bmatrix} \frac{1}{4}(I_0 + I_{90} + I_{45} + I_{135}) \\ I_0 - I_{90} \\ I_{45} - I_{135} \\ \mathrm{N/A} \end{bmatrix}$$

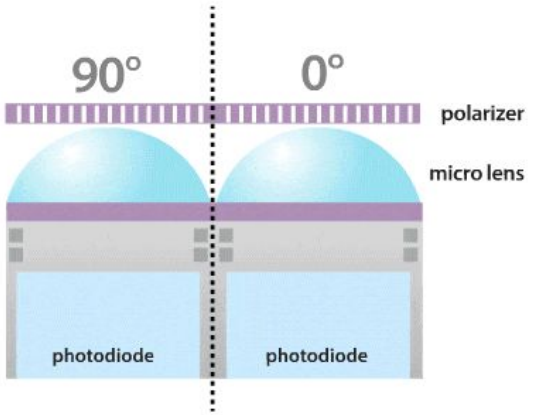
Stokes: Q, U, I



Sony’s polarization sensor reduces the chance of crosstalk thanks to the polarizer array being placed on-chip.

In the example below, the 0° polarized light is unable to enter the pixel meant to detect only 90°.





https://arxiv.org/pdf/2405.07864v1

Sub-percent Characterization and Polarimetric Performance Analysis of Commercial Micro-polarizer Array Detectors

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ABSTRACT

Polarization imaging can yield crucial information in multiple applications of remote sensing, such as characterization of clouds, aerosols, and the Aurora Borealis. Some applications require sub-percent polarimetric sensitivity and accuracy in determining the Stokes parameters, which can be a challenge to attain. In 2018, Sony released a low-cost CMOS-based imaging chip with integrated micro-polarizer array for general polarization measurements. We implement the calibration steps required for these Sony chips to reach sub-percent polarimetric accuracies. To analyze their performances, we have compared the characteristics of four different detector packages by three manufacturers housing either the monochromatic version or the RGB color variant. We present a comprehensive overview of the effects that these characteristics have on the polarimetric performance of the camera. They include dark noise, behavior over different gain settings, detector/pixel artifacts, and polarimetric effects determined by polarizer extinction ratios, polarizer orientations, and accuracy of polarimetric zero points due to differential pixel gains. In addition to calibrations using unpolarized light and fully linearly polarized light, we assess the polarimetric sensitivity within a tilting and rotating glass-plate set-up. We discuss the benefits of adding a rotating half-wave plate as an additional temporal modulator to generically mitigate some of the detector effects, and achieve better polarimetric sensitivity/accuracy albeit at the expense of lower temporal resolution. We conclude by presenting and discussing the polarimetric limits to which we were able to calibrate the detector effects for practical purposes. By reaching a compound absolute polarimetric uncertainty of less than a percent, these very compact, low-cost detectors are enabled for a multitude of scientific goals.

Keywords: MPA, DoFP, polarimeter, polarization, calibration, characterization, RGB polarimeter, mono polarimeter

With proper calibration: precision of ~0.001


ASTELCO

ıs ient Events Q, U, I, Light Analyzer

for COLIBRÍ

The fast telescope COLIBRÍ has opened-up a new window for **early GRB afterglow science**. This proposal is for adding the polarimetry capability to COLIBRÍ to monitor in real time the optical linear (Q, U, I) polarization of **bright** GRB afterglows (and other transients).

We propose to use a **new technology**, a sensor developed by Sony which is currently only targeting the industrial equipment, Sony Polarsens™ . This sensor capture the light polarization with a single acquisition over the entire image, pixel by pixel and can calculate real-time information about the direction and degree of polarization.

This technology has never been used on a telescope. This would serve as a test for low-cost polarimetry solutions for astronomy all around the world and if successful likely trigger R&D of cameras at other wavelengths (IR). This polarized camera will replace the “test camera” currently on COLIBRÍ.

Chronology
March 2025
First discussions with PI Alan Watson.
First discussion with companies (specs, quotes) and funding: Noémie Globus. (Noémie will bring the camera from the US.)
This project can involve a postdoc (Ny Avo Rakotondrainibe?)

CASK196

SVS-Vistek exo253ZU3
4096 x 3000 IMX253MZR USB3 Polarization Camera
Price: $4,064.00 each

Not available for purchase outside of North America.

Check Inventory | Add to Cart

- 4096 x 3000 12.3 MP camera captures polarized light
- Detects 0, 45, 135 and 90 degree polarization in a single shot
- 3 inputs, 4 outputs, plus RS232
- Integrated light control

Resolution [MP]	12.37
Horizontal Resolution [px]	4112
Vertical Resolution [px]	3008
Shutter Type	Global Shutter
Sensor Size	1.1 inch
Image Diagonal [mm]	17.58
Pixel Size x [µm]	3.45
Pixel Size y [µm]	3.45
Frame Rate [fps]	68.3
Chromatics	Polarized monochrome
Interface	LVDS
Bit Depth	8, 10, 12
Manufacturer	Sony
Aspect Ratio	4 : 1
Sensor Type	CMOS
Sensor Technology	Exmor
Protective Film	Yes
Package	LGA
Pins / Balls	226
Min. Storage Temperature [°C]	-10

"Tequila may not be the answer, but it's worth a shot”