

PolarCam™

4D TECHNOLOGY

4D Technology

Snapshot Micropolarizer Camera

The PolarCam micropolarizer camera captures a snapshot image of multiple polarization angles from each video frame, without image blur. Compact, fast and field-proven, these unique cameras enable a range of image enhancement techniques and polarimetric measurements, for applications in process control, medical imaging, remote sensing and more.

Proprietary micropolarizer technology enables the PolarCam's broad spectral response, wide angular bandwidth and high extinction ratio. The micropolarizer array is bonded directly to the sensor and includes no moving parts, providing a fully solid state, Division of Focal Plane (DoFP) configuration.

High-resolution PolarCam cameras are available with 0.29, 1.4, 1.8 and 3.8 mega-pixel sensors. The video rate of up to 259 full frames per second ensures fast capture of quickly changing scenes. The new CMOS high speed PolarCam can even provide up to 170 frames/second at its full 1248 x 1082 resolution. Using customizable regions of interest the CMOS cameras provide frame rates in the kilohertz range.

Optional PolarView™ software provides real-time display and calculation of key polarization parameters, including Degree of Linear Polarization (DoLP), Angle of Linear Polarization (AoLP), linear Stokes parameters (S_0 , S_1 and S_2) and more. Use the many included tools to process and analyze the data, then save images and movies of each parameter for comprehensive analysis.

An optional high speed computer system maximizes camera performance. 4D Technology can also provide complete illumination and imaging solutions based on the PolarCam. Contact 4D for more on custom imaging and sensing solutions.



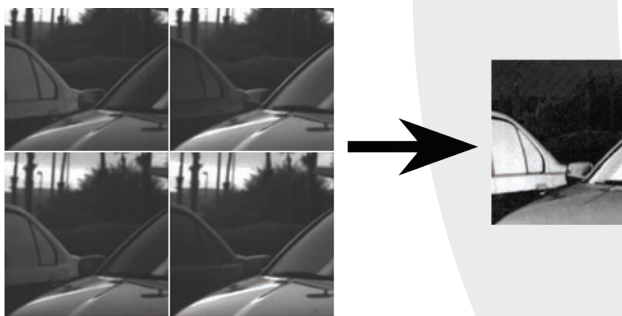
PolarCam CCD Camera



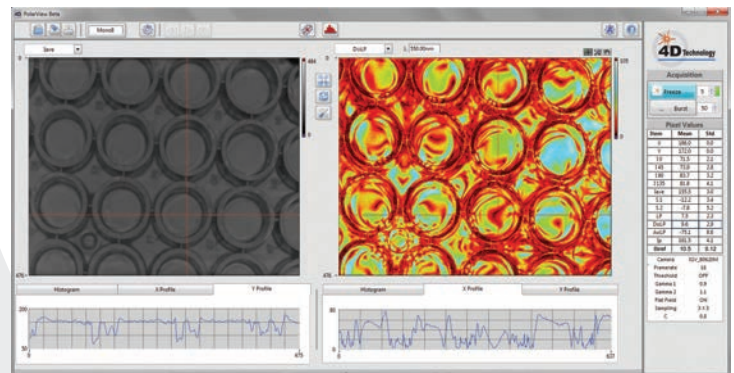
New! PolarCam CMOS High Speed Camera

APPLICATIONS

- Image Enhancement
- Glare Reduction and Haze Removal
- Birefringence Measurement
- Industrial Monitoring
- Polarization Microscopy
- Stress and Strain Characterization
- 3D Reconstruction
- Medical Imaging Enhancement
- Autonomous Vehicle Vision



Parsed pixelated camera polarization images are shown on the left. On the right, the contrast of the sky and trees in the background is reduced while the contrast of the two cars in the foreground is dramatically increased.



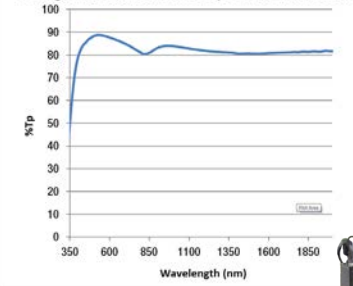
PolarCam map of birefringence in well plates due to stress. Average Intensity is shown on the left; the Degree of Linear Polarization (DoLP) is shown on the right.

PolarCam™

Specifications

Description	All PolarCam Models
Configuration	Snapshot Micropolarizer Camera Array
Acquisition Mode	Simultaneous polarization imaging (0, 45, 90, 135° linear polarizations)
Transmission	> 70%
Extinction Ratio	> 25:1
Color Format	Monochrome
Bit Depth	8, 10, 12-bit
Exposure	Global electronic shutter
Trigger	Internal/external exposure control
Temperature Range	Operational: 16–27° C (60–80° F), non-condensing Storage: -1–38° C (30–100° F), non-condensing
Computer System	Optional high performance desktop or laptop PC, Windows® 7 operating system
Software	Optional PolarView™ Polarization Software
	Live Video; capture and save images and bursts (movies)
	Calculated Output: Intensity; Averaged Intensity; Enhanced Polarization Image (I _p); Linear Stokes Parameters S ₀ , S ₁ , S ₂ ; Degree of Linear Polarization (0–100%, ±1%); Angle of Linear Polarization (-180–180°, ±1°); Birefringence (0–135nm, ±0.5nm at λ=500nm)
	Processed frame rate is processor and camera dependent
	Upgrades free during warranty period
Warranty	One Year, limited, standard; extendable

Wiregrid Polarizer Broad Spectral Bandwidth

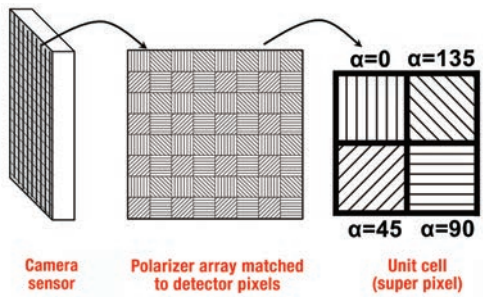


Wiregrid polarizers are suitable for use with cameras across a broad spectral bandwidth range from the UV to the near IR. Courtesy of Moxtek, Inc.

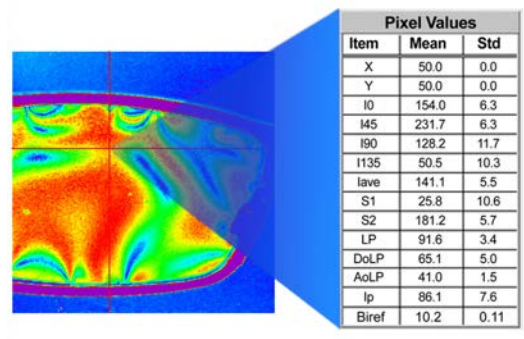


PolarCam is available as an OEM camera or as part of a complete testing system. Shown here is the PolarCam Birefringence Testing Station.

Description	Model					
	V	V-HS	M	H	New! CM	New! CM-HS
Sensor Type	Interline transfer CCD	Interline transfer CCD	Interline transfer CCD	Interline transfer CCD	CMOS Active Pixel	CMOS Active Pixel
Spectral Range	350 nm - 1060 nm	350 nm - 1060 nm	350 nm - 1060 nm	350 nm - 1060 nm	370 nm - 1000 nm	370 nm - 1000 nm
Pixel Size	7.4 μm	7.4 μm	7.4 μm	7.4 μm	8 μm	8 μm
Min. Usable Pixels	640 x 460	640 x 460	1500 x 1200	1950 x 1950	1312 x 1082	1248 x 1082
Frame Rate	135 fps	259 fps	30 fps	16 fps	54 fps	170 fps
Lens Mounting Type	C-Mount	C-Mount	C-Mount	F-Mount	C-Mount (CS optional)	C-Mount (CS optional)
Interface	GigE Ethernet	GigE Ethernet	GigE Ethernet	GigE Ethernet	GigE Ethernet	CameraLink
Physical Envelope	46 x 46 x 66 mm (1.8 x 1.8 x 2.6 in)	46 x 46 x 66 mm (1.8 x 1.8 x 2.6 in)	46 x 46 x 71 mm (1.8 x 1.8 x 2.8 in)	60 x 60 x 60 mm (2.4 x 2.4 x 2.4 in)	60 x 60 x 51 mm (2.4 x 2.4 x 2.0 in)	60 x 60 x 51 mm (2.4 x 2.4 x 2.0 in)
Power Requirement	4.7 W, 12 VDC	4.7 W, 12 VDC	4.9 W, 12 VDC	5.5 W, 12 VDC	5.2 W, 12 VDC	5.2 W, 12 VDC
Weight	210 g (0.46 lbs)	210 g (0.46 lbs)	210 g (0.46 lbs)	379 g (0.84 lbs)	310 g (0.68 lbs)	310 g (0.68 lbs)
PolarView option	Yes	Yes	Yes	Yes	Yes	No



A pattern of polarizers with four discrete polarizations (a "super pixel") is repeated over the entire micropolarizer array. The size and spacing of the micropolarizer elements is chosen to match the size and pitch of the camera sensor. The four polarizer orientations enable the linear Stokes parameters to be determined, from which the degree and angle of linear polarization can be determined.



PolarView software calculates, in real time, the Mean and Standard Deviation (Std) of parameters including DoLP, AoLP, Birefringence and the Enhanced Polarization Image (I_p).

All specifications subject to change without notice. PolarCam and PolarView are trademarks of 4D Technology Corporation. GigE, CameraLink and Windows are trademarks of their respective owners.