GO-5100MP-USB
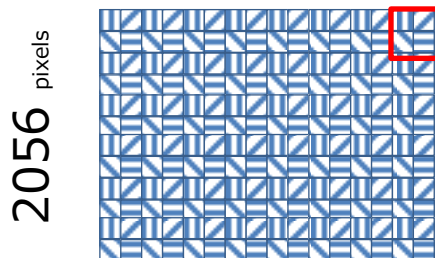# Various image output modes of Polarization

Jan 18, 2019

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POLARIZER ON EACH PIXEL
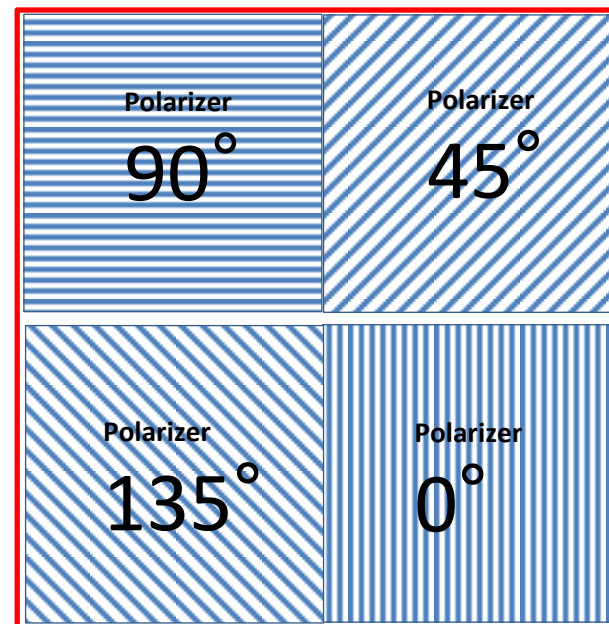
- Terminology:
  - Pixel:
    - Each pixel has a polarizer with different angle as shown in below drawing.
  - Block
    - A block consists of four pixels as shown in right drawing.

[Block]

[Pixels]   2464 pixels

2056 pixels

| Polarizer 90° | Polarizer 45° |
| Polarizer 135° | Polarizer 0° |

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See the possibilities

- Camera supports the following five image output modes that combine and process the values obtained by five calculations.

A   Raw Image

B   Four Polarize Element

C   Four Functions
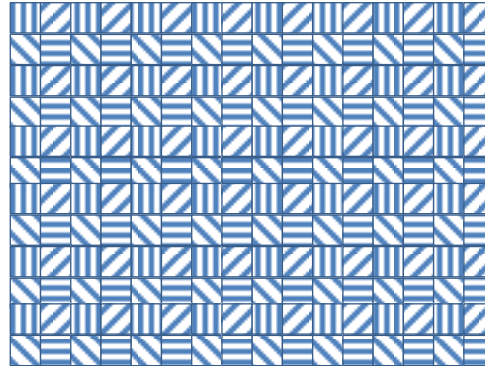
D   Color on picture

E   Color on Gray

A Raw Image

- Output from the image sensor is output from the camera as it is.

As the first line, as shown in the figure below, data of pixels with polarizer with 90° and 45° is output.
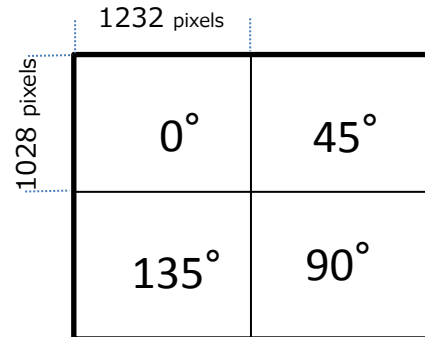In the second line, data of pixels with polarizer of 135° and 0° is output.

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FOUR POLARIZED ELEMENT

B

Four Polarize Element

It arranges the 4 division screen and outputs it.
(In the upper right, pixels with 0 ° polarizer angle, 45 ° to the lower left, 135 ° to the lower right, and 90 ° to the lower right)

1232 pixels

1028 pixels

0°	45°
135°	90°

FOUR FUNCTIONS

C **Four Functions**

Select any four from the five calculations (①, ②, ③, ④, ⑤) and display it on the split screen.
①**Polarize Angle**
②**Polarize Ratio**
③**Diffused Light**
④**Polarized Light**
⑤**Average Light**

The following example shows the case of outputting images of upper left : Polarize Angle, upper right: Polarize Ratio, lower left: Diffused Light, lower right: Polarized Light.

Settings
   item   Value
     PolarizeImageSelector: FourFunctions
     Panel1selector: PolarizeAngle
     Panel2selector: PolarizeRatio
     Panel3selector: DiffusedLight
     Panel4selector: PolarizedLight
*) It is also possible to assign the same information to each area of 4 split screen.

PolarizeAngle	PolarizeRatio
DiffusedLight	PolarizedLight

- This mode allows you to set each quadrant of the screen to one of five available functions. The five selectable functions are:
  - PolarizeAngle (polarization angle)
  - PolarizeRatio (polarization ratio)
  - DiffusedLight (diffused light)
  - PolarizedLight (polarized light)
  - AverageLight (average brightness)
- Each of the five functions expresses one value for a block from the distribution above.
- Then, all blocks are formed into 1028x1232 image and four of 1028x1232 images are shown as FourFunctions mode.

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- Five selectable functions are described below:
- By using intensity (gray value) of four pixels in a block, distribution of intensity against angles can be calculated for each block.
- From the distribution of intensity against angle of a block, the following values are expressed per each function:
  - Polarization angle:
    - The polarization angle producing the greatest luminance for a block.
    - Intensity values assigned to pixels represent angles from 0 to 180˚.
      - 8-bit output: 00000000 to 10110100
      - 10-bit output: 0000000000 to 1110000100
  - Polarization ratio:
    - The proportion of polarized light (at the angle described above) contained within the total light falling on a pixel block. Intensity values represent proportions of polarized light from 0 to 100%.
      - 8-bit output: 00000000 to 11111111
      - 10-bit output: 0000000000 to 1111111111

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- Diffused light:
  - The intensity of light falling on a pixel block when some or all of the polarized light is excluded. The ReflectionAdjust control determines how much of the polarized component is removed. The higher the ReflectionAdjust setting, the more polarized light is removed. Set to maximum to display only the diffused component.
  - If the ReflectionAdjust is set to 100%, it is the lowest intensity of the distribution.
- Polarized light:
  - The intensity of the polarized light that is falling on a pixel block after the diffused light has been excluded.
  - It is the highest intensity of the distribution.
- Average light:
  - The brightness of a pixel block when the polarized component and the diffused component are averaged.
  - It is the average of the distribution.

D | **Color on picture**
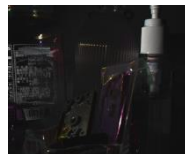
On the image with average luminance, images with information of polarization angle and degree of polarization expressed in color are superimposed and displayed.
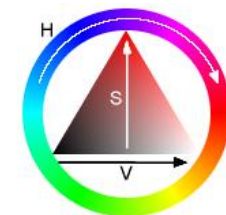In this mode, PixelFormat automatically changes as follows.

Output images with BayerRG8 when PixelFormat is Mono8.
Output images with BayerRG10 when PixelFormat is Mono10.
Output images with BayerRG10packed when PixelFormat is Mono10Packed.

Add polarization information (polarization angle, polarization degree, lightness)
to the average value image as color information using the HSV color space.
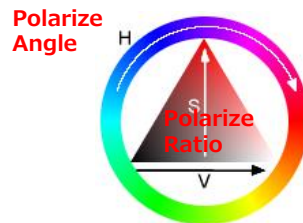
HSV: Hue,   Saturation,   Value

polarization
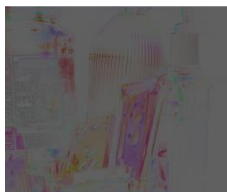information   **PolarizeAngle, PolarizeRatio,**   Value

Polarize Angle

Polarize Ratio

+   =

dential

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(E)

Color on Gray

On the gray image, images with information of polarizing angle and degree of polarization expressed in color are superimposed and displayed.
In this mode, PixelFormat automatically changes as follows.

Output images with BayerRG8 when PixelFormat is Mono8.
Output images with BayerRG10 when PixelFormat is Mono10.
Output images with BayerRG10packed when PixelFormat is Mono10Packed.

Add polarization information (polarization angle, polarization degree, lightness)
to the gray image as color information using the HSV color space.
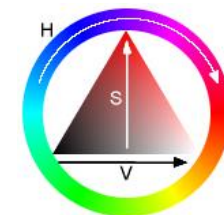
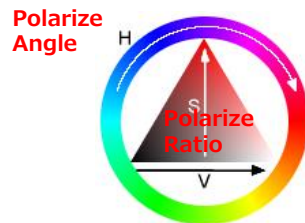HSV: Hue,   Saturation,   Value

polarization
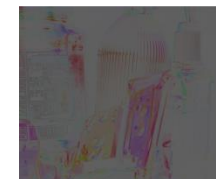information   **PolarizeAngle, PolarizeRatio,**   Value

Polarize Angle

Polarize Ratio

+

dential

=

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THANK YOU

for seeing the possibilities