



KAYA Frame Grabbers Color Geometric Distortion Correction

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2.1 Safety Precautions

Please take a minute to read carefully the precautions listed below in order to prevent unnecessary injuries to you or other personnel or cause damage to property.

- **Before using the product, read these safety precautions carefully to assure correct use.**
- **These precautions contain serious safety instructions that must be observed.**
- **After reading through this manual, be sure to act upon it to prevent misuse of product.**



Caution

<p>In the event of a failure, disconnect the power supply. If the product is used as is, a fire or electric shock may occur. Disconnect the power supply immediately and contact our sales personnel for repair.</p>
<p>If an unpleasant smell or smoking occurs, disconnect the power supply. If the product is used as is, a fire or electric shock may occur. Disconnect the power supply immediately. After verifying that no smoking is observed, contact our sales personnel for repair.</p>
<p>Do not disassemble, repair or modify the product. Otherwise, a fire or electric shock may occur due to a short circuit or heat generation. For inspection, modification or repair, contact our sales personnel.</p>
<p>Do not touch a cooling fan. As a cooling fan rotates in high speed, do not put your hand close to it. Otherwise, it may cause injury to persons. Never touch a rotating cooling fan.</p>
<p>Do not place the product on unstable locations. Otherwise, it may drop or fall, resulting in injury to persons or failure.</p>
<p>If the product is dropped or damaged, do not use it as is. Otherwise, a fire or electric shock may occur.</p>
<p>Do not touch the product with a metallic object. Otherwise, a fire or electric shock may occur.</p>
<p>Do not place the product in dusty or humid locations or where water may splash. Otherwise, a fire or electric shock may occur.</p>
<p>Do not get the product wet or touch it with a wet hand. Otherwise, the product may break down or it may cause a fire, smoking or electric shock.</p>
<p>Do not touch a connector on the product (gold-plated portion). Otherwise, the surface of a connector may be contaminated with sweat or skin oil, resulting in contact failure of a connector or it may cause a malfunction, fire or electric shock due to static electricity.</p>
<p>Do not use or place the product in the following locations:</p> <ul style="list-style-type: none"> • Humid and dusty locations • Airless locations such as closet or bookshelf • Locations which receive oily smoke or steam • Locations close to heating equipment • Closed inside of a car where the temperature becomes high • Static electricity replete locations

- Locations close to water or chemicals

Otherwise, a fire, electric shock, accident or deformation may occur due to a short circuit or heat generation.

Do not place heavy things on the product.

Otherwise, the product may be damaged.

Be sure to drain static electricity from body before you touch any electronics component

The electronic circuits in your computer and the circuits on KAYA's Frame Grabber board are sensitive to static electricity and surges. Improper handling can seriously damage the circuits. In addition, do not let your clothing come in contact with the circuit boards or components.

Otherwise, the product may be damaged.

2.2 Disclaimer

This product should be used for interfacing of imaging devices and acquiring of video streams. KAYA Instruments assumes no responsibility for any damages resulting from the use of this product for purposes other than those stated.

Even if the product is used properly, KAYA Instruments assumes no responsibility for any damages caused by the following:

- Earthquake, thunder, natural disaster or fire resulting from the use beyond our responsibility, acts caused by a third party or other accidents, the customer's willful or accidental misuse or use under other abnormal conditions.
- Secondary impact arising from use of this product or its unusable state (business interruption or others).
- Use of this product against the instructions given in this manual or malfunctions due to connection to other devices.

KAYA Instruments assumes no responsibility or liability for:

- Erasure or corruption of data arising from use of this product.
- Any consequences or other abnormalities arising from use of this product, or damage of this product not due to our responsibility or failure due to modification.

Repair of this product is carried out by replacing it on a chargeable basis, not repairing the faulty devices. However, non-chargeable replacement is offered for initial failure if such notification is received within two weeks after delivery of the product.

3.1 Overview

The purpose of this document is to describe the configuration and usage of the Color Geometric Distortion Correction and the Metadata insertion mechanism.

Both are hardware based implemented for faster performance and easily controlled from software using Gen*i*cam interface.

All the parameters described in this document are frame grabber parameters and can be accessed from GUI Frame Grabber tab in the project navigator or from API using KYFG_SetGrabberValue and KYFG_GetGrabberValue function variations.

4.1 1-D multi-spectral spatial correction

The corrector compensates spatial distortion along a single image line. The same correction is applied on all the lines of the captured image.

For every incoming line of “raw” RGB24 pixels, the corrector delivers one line of “corrected” RGB24 pixels having the same length. In this case, there are 4096 pixels.

The corrector operates on each color plane separately. A different spatial correction can be applied on each color component: R, G, and B components in this case. This feature allows the correction of chromatic aberrations.

4.2 Spatial Correction Principle

For each pixel position P along the delivered line of pixels, the corrector delivers, for each component separately, the estimated pixel component data corresponding to the corrected position P' described in the following correction principle:

$$\begin{aligned} R_{out}(P) &= R_{in}(P_{R'}); P_{R'} = P + P_{offset_R}(P) \\ G_{out}(P) &= G_{in}(P_{G'}); P_{G'} = P + P_{offset_G}(P) \\ B_{out}(P) &= B_{in}(P_{B'}); P_{B'} = P + P_{offset_B}(P) \end{aligned}$$

The Position Offset values are specific to each component (R, G, B) and each position P .

4.2.1 Interpolation

The corrector uses linear interpolation between two adjacent pixels to estimate the pixel component data of the corrected position P' . P' is a positive value composed of an integer part P'_{INT} and a fractional part P'_{FRAC} .

The interpolator estimates the pixel component data using the following formula:

$$(P') = (P'_{INT}) * (1 - P'_{FRAC}) + Data(P'_{INT} + 1) * P'_{FRAC}$$

4.2.2 Operating Limits

The corrector will exhibit some operating limits regarding the Position Offset values:

- The range of position values will be restricted to a window of 256 pixels allowing position offsets in the range of -128 up to +127.
- The fractional part is defined in steps of 1/256th.
- Corrector will affect maximum of 4096 pixels.

4.3 Configuration steps

To configure the Color Distortion Corrector the following steps should be taken:

1. A color channel(Blue, Green or Red) should be selected by setting the “ColorDistortionCorrectionSelector”
2. The mode of data loading should be set to “Normal” using the parameter “ColorDistortionCorrectionLoadMode”. Afterwards, initial color channel address should be selected by setting the “ColorDistortionCorrectionAddress”.
3. The desired mode of data loading should be defined using the “ColorDistortionCorrectionLoadMode”.
4. If “Incremental” Load Mode is selected then data value should be written to “ColorDistortionCorrectionValue”, each write will update the selected pixel color channel correction value and increment the “ColorDistortionCorrectionAddress”;
On the other hand, if “Normal” Load Mode is selected, on each transection the “ColorDistortionCorrectionAddress” should be updated and data value write/read could follow, for selected pixel color channel correction address.
5. Corrector may be enabled/disabled using the “ColorDistortionCorrectionEnable” parameter.

Example code:

```
CAMHANDLE camHandle;

KYFG_SetGrabberValueEnum_ByValueName(camHandle,“ColorDistortionCorrectionSelector”,
“DistortCorrectChannelBlue”);
KYFG_SetGrabberValueEnum_ByValueName(camHandle,“ColorDistortionCorrectionLoadMode”,
“Normal”);
KYFG_SetGrabberValueInt(camHandle,“ColorDistortionCorrectionAddress”, 0);
KYFG_SetGrabberValueEnum_ByValueName(camHandle,“ColorDistortionCorrectionLoadMode”,
“Incremental”);
for(size_t iValueReg = 0; iValueReg < 4096; iValueReg++)
{
    int64_t value = ((int64_t)rand() % 256) - 128; // range of -128 up to +127
    KYFG_SetGrabberValueInt(camHandle,“ColorDistortionCorrectionValue”, value);
}
KYFG_SetGrabberValueEnum_ByValueName(camHandle,“ColorDistortionCorrectionEnable”,
“Enable”);
```


The color Geometric Distortion Correction parameters are described in Table 1.

Parameter	Description	Gen <i><i>Cam</i> name	Type	Possible values		Remarks
				Value	Gen <i><i>Cam</i> name	
Gen <i><i>Cam</i> Category: ExtendedStreamFeatures \ ColorGeometricDistortionCorrection						
Distortion Correction Selector	Color channel select for Distortion Correction mechanism	ColorDistortionCorrectionSelector	Enumeration	0	DistortCorrect ChannelBlue	
				1	DistortCorrect ChannelGreen	
				2	DistortCorrect ChannelRed	
Distortion Correction Enable	Enable the Color Distortion Correction mechanism	ColorDistortionCorrectionEnable	Enumeration	0	Disable	
				1	Enable	
Distortion Correction Data Load Mode	Data loading method for Color Distortion Correction	ColorDistortionCorrectionLoadMode	Enumeration	0	Normal	
				1	Incremental	
Distortion Correction Reg Address	Color Distortion Correction selected register address	ColorDistortionCorrectionAddress	Integer	0 – 4096		
Distortion Correction Reg Value	Color Distortion Correction selected register value	ColorDistortionCorrectionValue	Float	-128 – +127		

Table 1 : Color transformation control parameters

5.1 Metadata Insertion

When the Metadata insertion feature is activated, some Metadata information will be delivered along or instead to the data stream. The inserted information will be configured according to selected Metadata insertion mode.

5.1.1 Model

When the Metadata insertion Model is activated, the first 10 bytes of each image line are replaced by a fixed set of metadata information as follows:

- The logical state of System I/O input lines
- The value of the motion encoder pulse counter
- The value of the Camera Link LVAL pulse counter

Bit	Function
0	OptoCoupled Input 0
1	OptoCoupled Input 1
2	OptoCoupled Input 2
3	OptoCoupled Input 3
4	OptoCoupled Input 4
5	OptoCoupled Input 5
6	OptoCoupled Input 6
7	OptoCoupled Input 7
8	LVDS Input 0
9	LVDS Input 1
10	LVDS Input 2
11	LVDS Input 3
12	TTL 0
13	TTL 1
14	TTL 2
15	TTL 3

Table 2 : System I/O input lines

Format of the metadata for each line in bytes:

3:0	7:4	9:8	EOL:10
Camera Link LVAL pulse counter (32 bit Little Endian) The counter resets on start of acquisition	Motion encoder 0 pulse counter (32 bit Little Endian)	Logical state of System I/O input lines (16 bit Little Endian)	Video raw data

*EOL – End Of Line

To set up the Encoder pulse counters please follow document “KAYA’s_Frame_Grabber_Programming_Start-up_Guide.pdf”.

The metadata control parameters are described in Table 3.

Parameter	Description	Gen<i>Cam name	Type	Possible values		Remarks
				Value	Gen<i>Cam name	
Gen<i>Cam Category: ExtendedStreamFeatures \ MetaDataControl						
Meta Data Enable Mode	Inserts metadata information according to	MetaDataMode	Enumeration	0	Disable	
				1	Model	

Table 3 : Metadata control parameters