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Teledyne DALSA • 880 Rue McCaffrey • St-Laurent, Québec, H4T 2C7 • Canada
<http://www.teledynedalsa.com/Genie-Nano>

G3-ANCL04-V1: Genie Nano-CL Application Note

In-Camera Flat Line & Lens Shading Correction Calibration Procedure

*Part numbers: G3-CM10-M4095, G3-CM10-M5105 & G3-CM10-M510550
(using any firmware version — 10-Tap/8-Tap/3-Tap)*

Overview

This application note for Genie Nano-CL Camera Link cameras (16M and 25M models using OnSemi Python sensors) describes the procedures for Flat Line calibration and Block Lens Shading calibration, which are performed by the user in the field.

The user calibrated set of correction coefficients is used then to provide a consistent automatic correction to sensor or lens deficiencies. Flat Line correction coefficients mathematically smooth out pixel variations and even replace dead pixel data to provide improved overall sensor quality.

These two procedures use Sopera LT and the CamExpert tool provided. A Teledyne DALSA Camera Link frame grabber was used to control and capture image data from the Nano-CL. The camera used for screen shots is the Nano-CL 25M (5120x5120).

Flat Line Correction Overview

Camera sensors pixel columns have slight signal differences due to inherent electrical variations in the column readout circuits, even when exposed to perfectly uniform illumination. This procedure samples a center horizontal band of the sensor to analyze the column variations and produce a Flat Line correction coefficients set.

Lens Shading Correction Overview

The term "shading" describes the characteristic of a lens which typically reduces the amount of light transmission towards the edges of an image relative to the center of the image. A simple example would be lens vignetting when a lens image circle is too small for the sensor, but also includes cases where a lens of lesser quality does not transmit light equally through its edges as compared to its center. Shading correction coefficients mathematically equalize sensor data, compensating for any lens errors.

Preparations before executing the Calibration Procedures

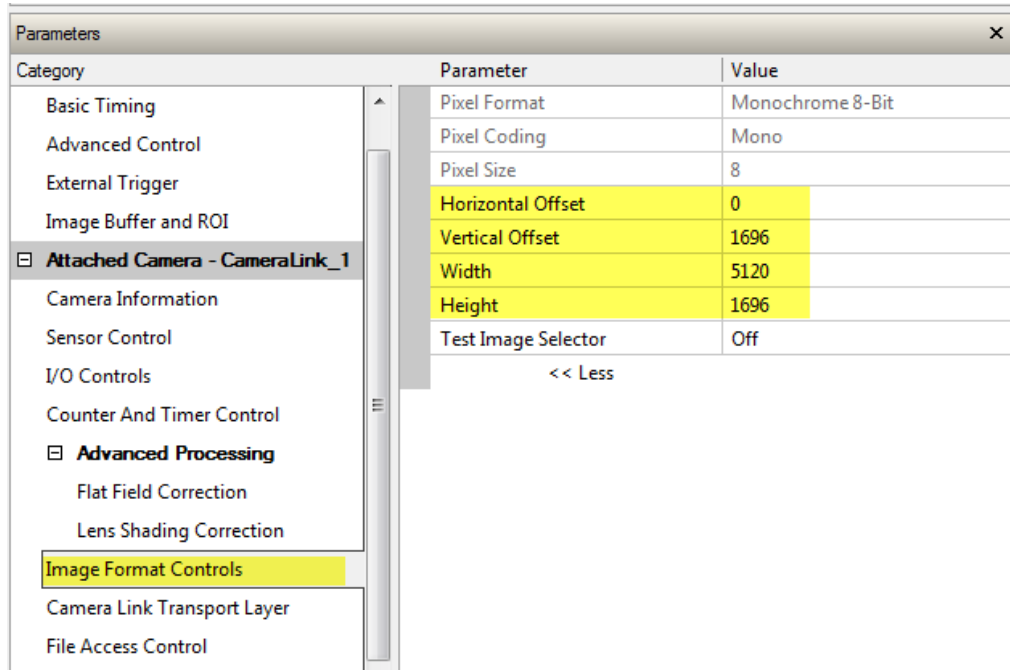
- Install Sopera LT, a Teledyne DALSA frame grabber and a Nano-CL.
- Update the frame grabber driver and Nano firmware if required.
- Start CamExpert, configure the frame buffer size, sensor geometry and apply power to the Nano.
- Test with a live acquisition. Refer to Nano-CL or CamExpert documentation if required.

1. Calibration Procedure for Flat Line Correction

This procedure sets the active acquisition area to a band of rows across the center of the sensor to eliminate possible lens shading effects in the corners of the rectangular sensor.

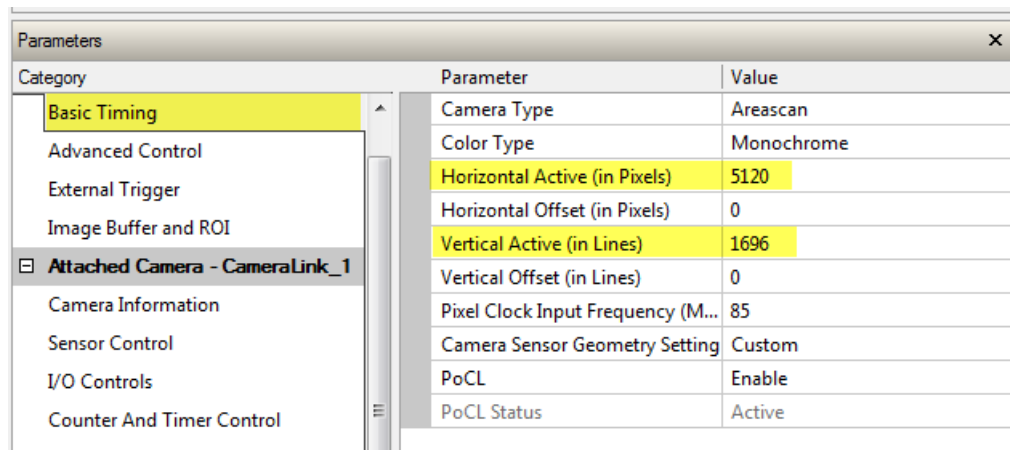
Camera & Frame Grabber Setup

- Set the camera Image Format Controls to the following values and also set the Frame Grabber Buffer Format to match.
(Horizontal Offset=0, Width=5120, Height=1696, Vertical Offset=1696).



The screenshot shows the 'Parameters' dialog box with the 'Image Format Controls' category selected. The following table represents the data shown in the parameter list:

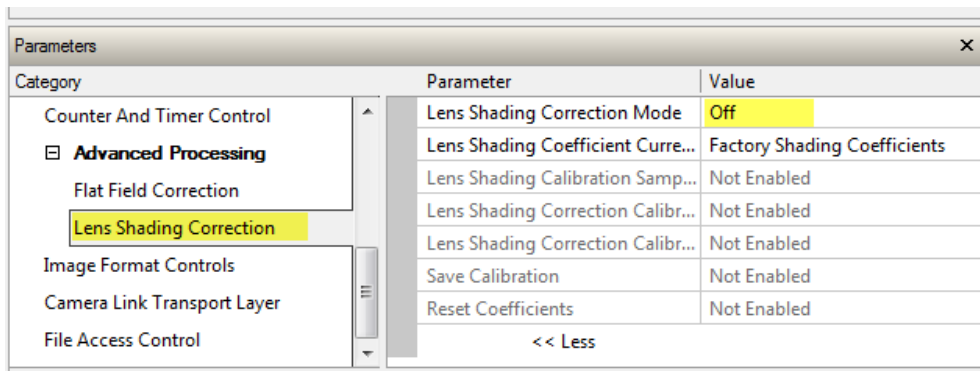
Parameter	Value
Pixel Format	Monochrome 8-Bit
Pixel Coding	Mono
Pixel Size	8
Horizontal Offset	0
Vertical Offset	1696
Width	5120
Height	1696
Test Image Selector	Off



The screenshot shows the 'Parameters' dialog box with the 'Basic Timing' category selected. The following table represents the data shown in the parameter list:

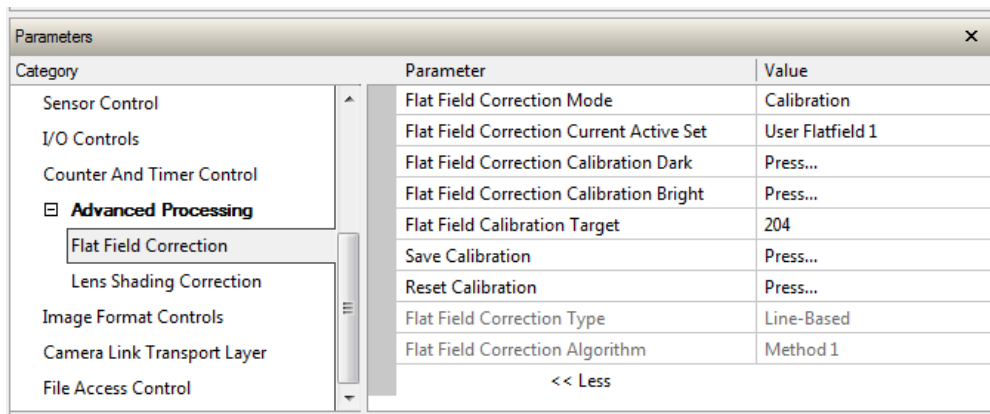
Parameter	Value
Camera Type	Areascan
Color Type	Monochrome
Horizontal Active (in Pixels)	5120
Horizontal Offset (in Pixels)	0
Vertical Active (in Lines)	1696
Vertical Offset (in Lines)	0
Pixel Clock Input Frequency (M...	85
Camera Sensor Geometry Setting	Custom
PoCL	Enable
PoCL Status	Active

- Disable the Lens Shading Correction feature at this time. This must be off for Flat Line calibration.



Flat Line Correction Calibration

The Flat Field Correction category as shown in the following screen capture has the features required for a dark and bright calibration.



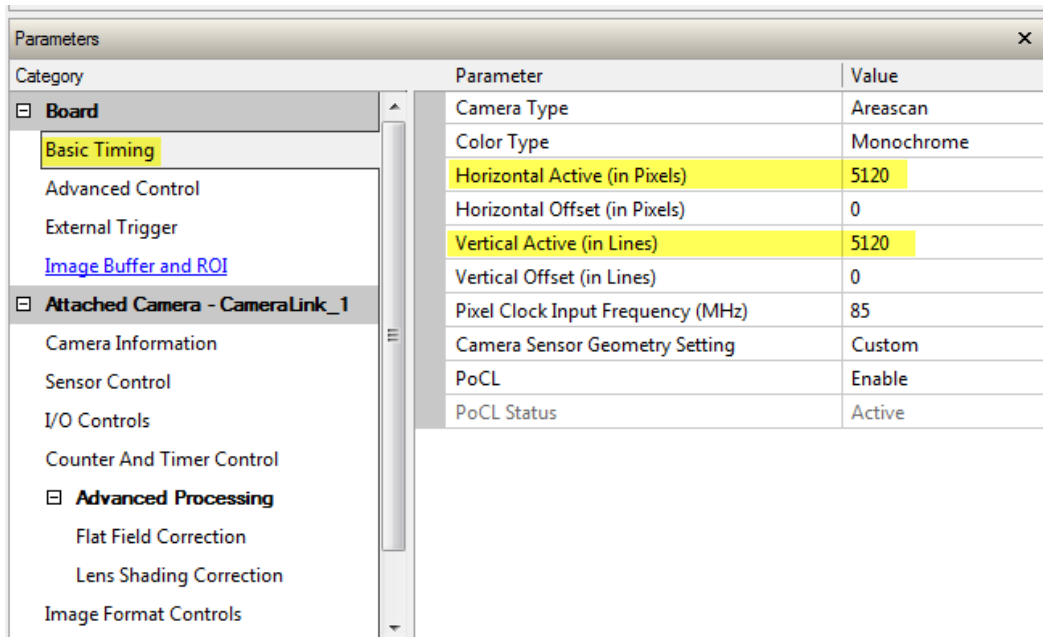
- Set the *Flat Field Correction Mode* feature to *Calibration*.
- Set the *Flat Field Correction Current Active Set* feature to *User Flatfield1*.
- Clear the flat line coefficients by clicking the Button *Reset Calibration*.
- Reduce the exposure time, close the lens iris and cover the lens with a lens cap to ensure that no light reaches the sensor.
- Execute the *Flat Field Correction Calibration Dark* function with a click of the button.
- Remove the lens cap and aim the camera at white paper or a white wall that's evenly lit. Adjust the iris and exposer time for a bright image acquisition, that's around 80% saturation (about 0xCC pixel value over most of the image). A clean lens and sensor is required for proper calibration.
- Set the *Flat Field Calibration Target* to 204DN.
- Execute the *Flat Field Correction Calibration Bright* with a click of the button.
- Click on *Save Calibration* to store the coefficients in *User FlatField1*.
- Return the frame grabber image buffer and camera acquisition settings back to the full sensor size of the camera used (in this example 5120x5120).
- Set the *Flat Field Correction Mode* feature to *Active*. The user can choose either the *User Flatfield1* or factory coefficients, as required.

2. Calibration Procedure for Lens Shading Correction

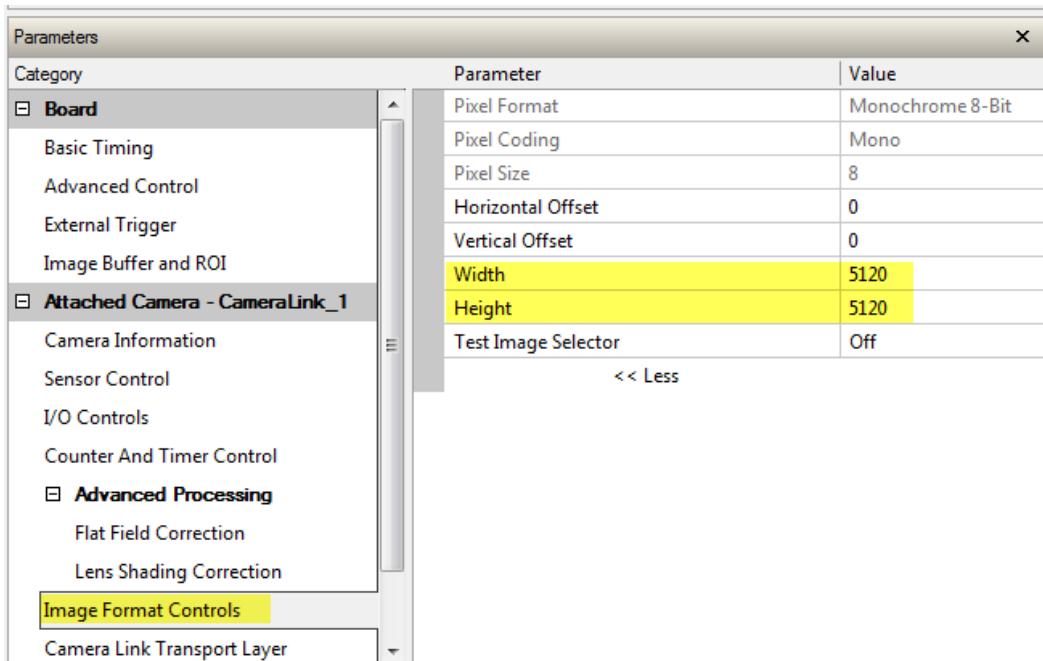
This procedure sets the active acquisition area to the complete sensor acquisition area (in this example the Nano-CL 25M is 5120x5120).

Camera & Frame Grabber Setup

- Set the camera Image Format Controls to the following values and also set the Frame Grabber Buffer Format to match.

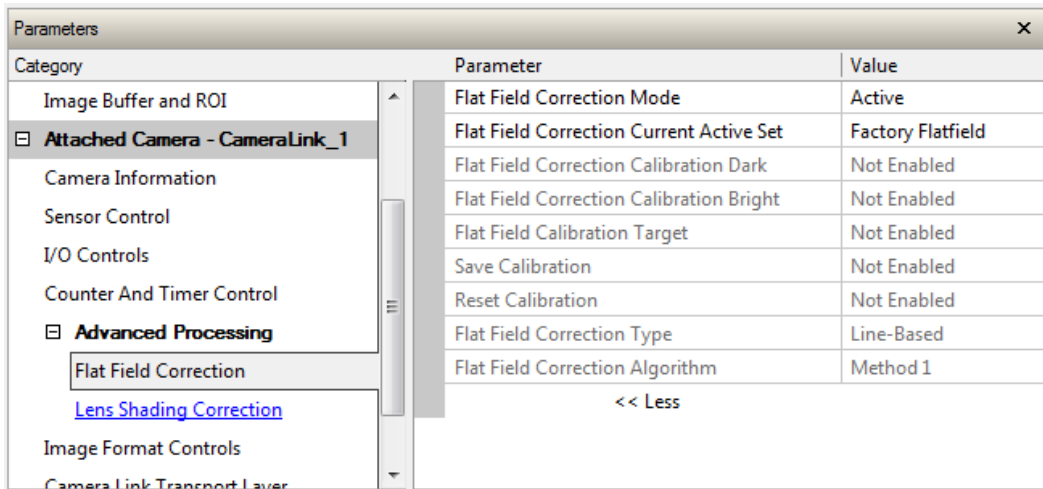


Category	Parameter	Value
Board	Camera Type	Areascan
	Color Type	Monochrome
	Horizontal Active (in Pixels)	5120
	Horizontal Offset (in Pixels)	0
	Vertical Active (in Lines)	5120
	Vertical Offset (in Lines)	0
	Pixel Clock Input Frequency (MHz)	85
	Camera Sensor Geometry Setting	Custom
	PoCL	Enable
	PoCL Status	Active



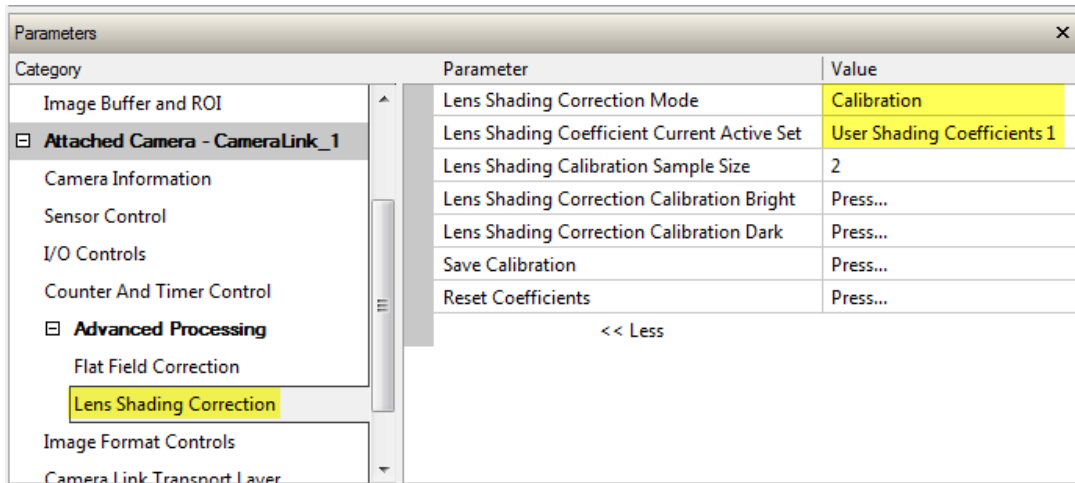
Category	Parameter	Value
Attached Camera - CameraLink_1	Pixel Format	Monochrome 8-Bit
	Pixel Coding	Mono
	Pixel Size	8
	Horizontal Offset	0
	Vertical Offset	0
	Width	5120
	Height	5120
	Test Image Selector	Off

- Before performing the shading correction calibration, verify that the *Flat Field Correction Mode* feature is *Active*.



Lens Shading Correction Calibration

The Lens Shading Correction category as shown in the following screen capture has the features required for a dark and bright calibration.



- Set the *Lens Shading Correction Mode* feature to *Calibration*.
- Set the *Lens Shading Correction Current Active Set* to *User Shading Coefficients 1*.
- Clear the Lens Shading Coefficients by clicking the Button *Reset Coefficients*.
- Reduce the exposure time, close the lens iris and cover the lens with a lens cap to ensure that no light reaches the sensor.
- Execute the *Lens Shading Correction Calibration Dark* function with a click of the button.
- Remove the lens cap and aim the camera at white paper or a white wall that's evenly lit. Adjust the iris and exposure time for a bright image acquisition, that's around 80% saturation (about 0xCC pixel value over most of the image). A clean lens and sensor is required for proper calibration.
- Execute the *Lens Shading Correction Calibration Bright* with a click of the button.

- Click on *Save Calibration* to store the coefficients in *User Shading Coefficients 1 (or 2)*
- To enable the *Lens Shading Correction Mode* feature select the *Active mode*. The user can then choose either the *User Shading Coefficients 1 or 2* or factory coefficients, as required.