GM8136

ISP TUNING TOOL

User Guide
Rev.: 1.3
Issue Date: December 2014

REVISION HISTORY

GM8136 ISP Tuning Tool User Guide

Date	Rev.	From	To
Dec. 2014	1.3	-	Original

Printed in Taiwan 2014

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Chapter 1

Introduction

This chapter contains the following sections:

1.1 Description

This tuning tool is a highly integrated image adjustment and sensor calibration tool. Users can use this tool to perform the image quality analysis, sensor calibration, and image preferring adjustment. After tuning and calibration are completed, the resulting parameters can be saved as the configure file of the Grain Media Linux ISP driver. The calibration results will be the default settings after GM camera device was booted.

1.2 Definition

A, CWF, D65	CIE standard illuminants used in light box
ColorChecker	X-Rite ColorChecker Classic chart
GM_IspTool	ISP image quality tuning tool provided by Grain Media.
Grayscale	Gray scale charts such as ITE Gray Scale, Kodak Gray Scale, and so on
isp_demon	A Linux server application provided by Grain Media It is used to serve commands that come from GM_IspTool.
ROI	Region of interest
SDK	Software development kit provided by Grain Media.
Sensor Configure File	The ISP configure file which was assigned within the booting procedures to load the default parameters for the specified sensor.

1.3 Installation

This tuning tool can run under Windows 98/2000/XP/7. To install this tool, please double-click on the "Setup" icon in the CD folder. This starts the installation wizard. After installation, a shortcut to GM_IspTool, will be placed on the desktop, and an entry "Grain Media" is created on the Windows Start Menu.

From the Start/Grain Media entry, users can run GM_IspTool or uninstall the software.

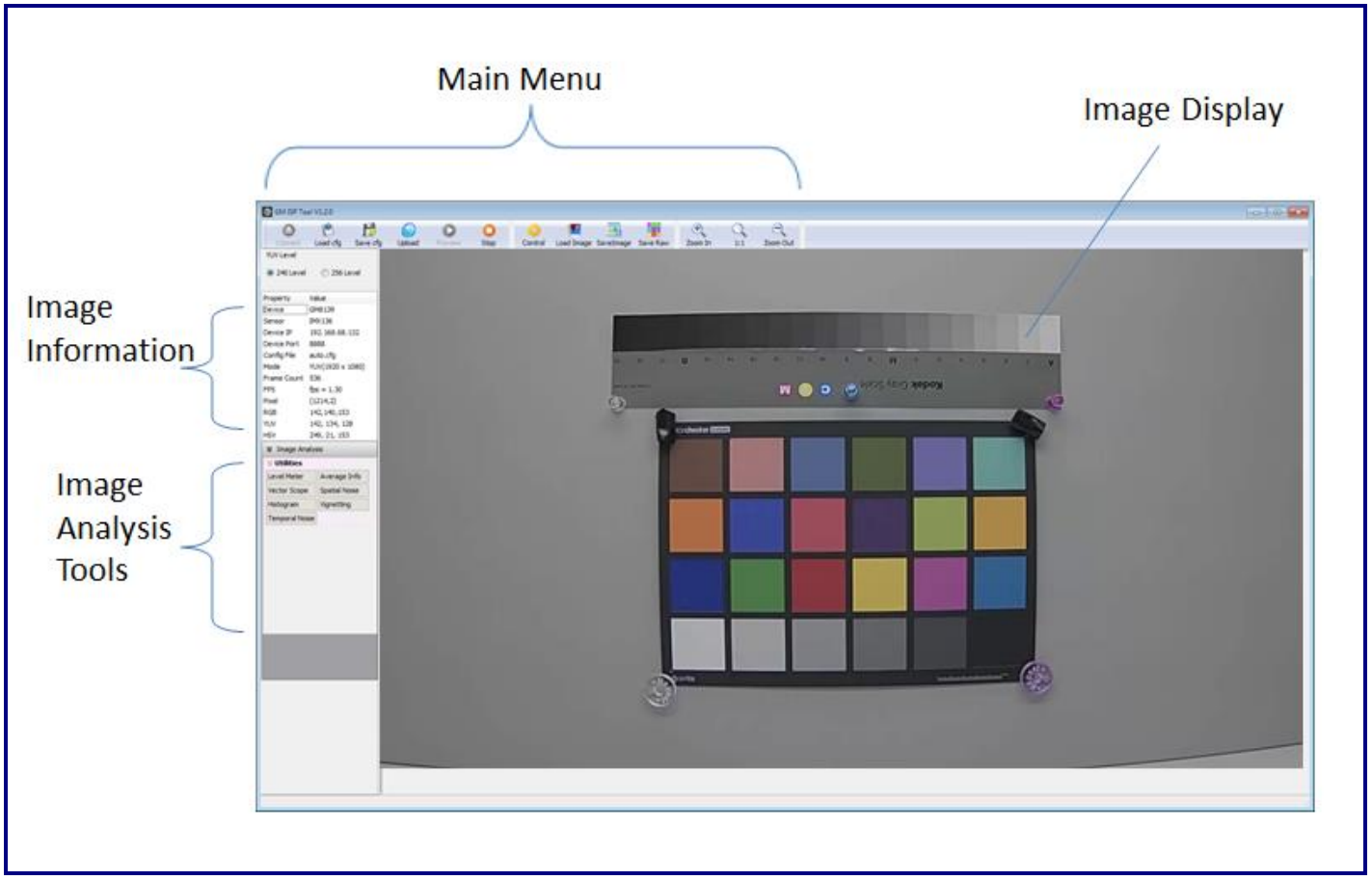
Chapter 2

Getting Started

This chapter contains the following sections:

2.1 GUI Introduction

Below is the main window of GM_Isp tool.



2.1.1 Main Menu

Main Menu provides the interface for involving the main functions of GM_IspTool. These buttons are explained as follows:

	GM_IspTool is designed for all GM camera devices. This button is used to select the target device and try creating the connection to the target device.
	Load the target configuration file which saves the calibration result and apply all parameters to the device. Please note that the tool will check if the configuration matches to the target device.
	Save calibration will result to the configuration file of the destination.
	After calibration, users can upload the current configuration into the device to apply all new parameters.
	Start image preview process. This process will be auto-created after connecting to the target device.
	Pause the preview process
	Involve the image calibration window
	Load image for off-line image analysis
	Save the current image frame to file
	Save raw data of the current image frame to file
	Scale up the current displayed image. The maximum scaling ration is 400% for both width and height.
	Reset the scaled image to 1:1.
	Scale down the current displayed image. The minimum scaling ration is 15% for both width and height.

2.1.2 Image Information

Image information includes:

Device	Current target GM camera device
Sensor	Current sensor device
Device IP	IP address of the target device
Device Port	isp_demon port No. of the target device
Config File	Current target configuration file
Mode	Data type and resolution
Frame Count	Count of frames starting from the connected device
FPS	Frame rate of the preview process
Pixel	The coordinates of a pixel where cursor points to
RGB	RGB value of a pixel where cursor points to
YUV	YUV value of a pixel where cursor points to
HSV	HSV value of a pixel where cursor points to
Zoom	Show current scaling ration

2.1.3 Image Quality Analysis Tools

This area contains several helpful image quality analysis tools and will be explained in the following sections.

2.1.4 Image Display

This area shows the real-time image captured from the target device. Users can immediately check the tuning result and perform the image quality analysis by using the real-time image. Also, GM_IspTool can directly grab the raw image as the calibration material for saving time.

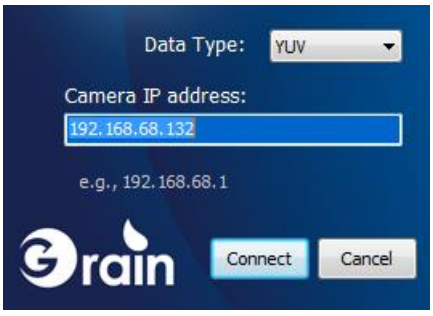
2.2 Calibration

To do calibration, users first need to connect GM_IspTool to the target device.

2.2.1 Device Connection

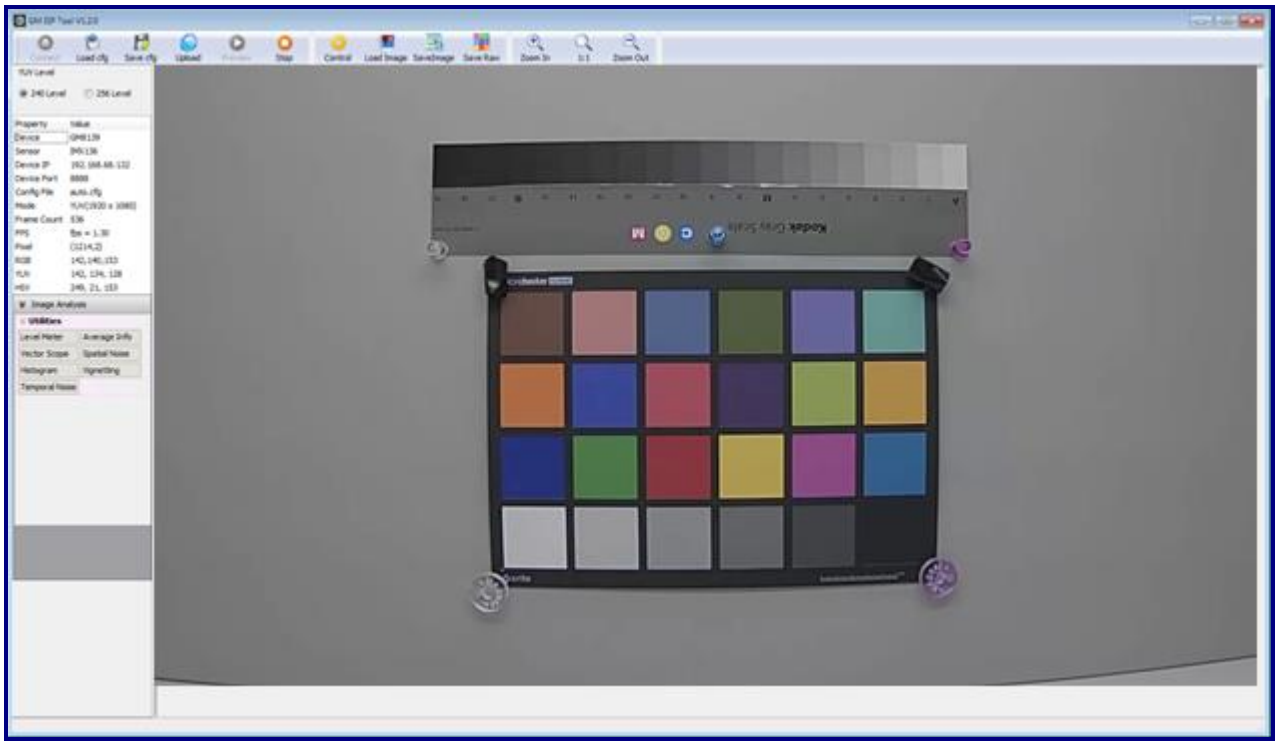
The following procedures are used to connect the GM device (Ex.: GM8139) to GM_IspTool:

1. Prepare the target device
   (1) Add the module parameters, "**usr_func=1 usr_param=1"**, before inserting **vpd_slave.ko.**
   Ex.: /sbin/insmod /lib/modules/vpd_slave.ko vpslv_dbglevel=0 ddr0_sz=0 ddr1_sz=0 config_path="/mnt/mtd/" **usr_func=1 usr_param=1**
   (2) Boot GM8139 and run ispd_demon with the following command:
   isp_demon [PortNo], PortNo is optional, the default is 8888.
2. Connect GM_IspTool to the target device
   (1) Run GM_IspTool, and the connection dialog will be shown. Select Data Type (YUV for RAW data and Stream for encoded data) and assign the IP address of the target device (e.g., 192.168.0.105). In the popped dialog, click "Connect".



   (2) When the connection is successful, tool will automatically download the sensor configuration file from the device and show the file as "auto.cfg". Users can also click on the "load cfg" button to load the prepared sensor configuration file from PC as the target configuration file.

If the connection was created successfully, the real-time image will be displayed in the Image Display area as follows:

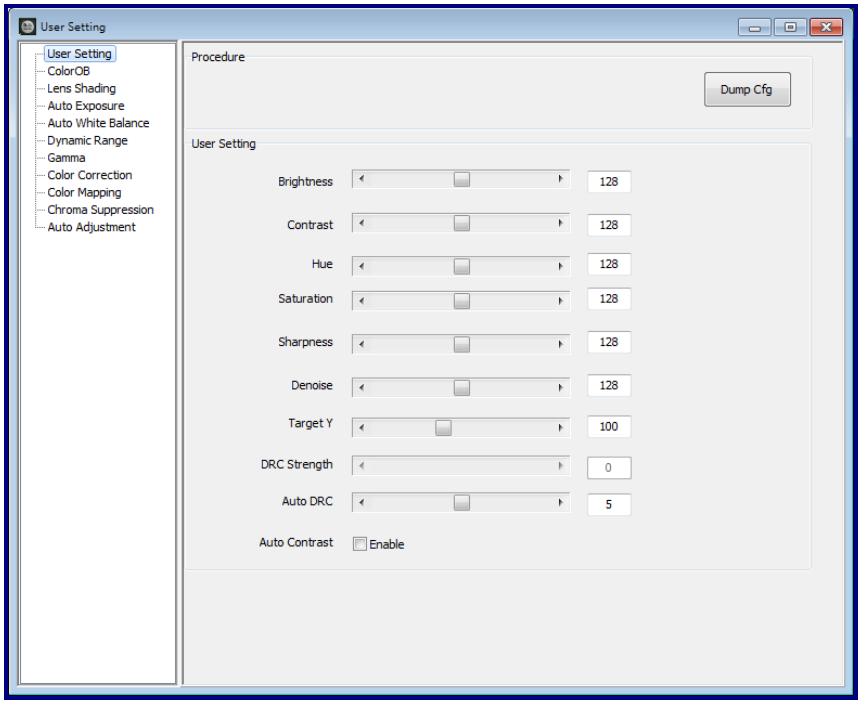


If the connection failed, an error message, “ISP device connect fail”, will pop up. Users can confirm the IP address and Ethernet wire and retry again.

2.2.2 Start Calibration

After the device is connected to GM_IspTool, the "Control" button 

will be enabled. Clicking on this button will involve the configure window. This window contains all pages for image adjustment and sensor calibration. By clicking on the "function list" at the left side, the corresponding page will be shown in the main panel at the right side.



2.3 Saving Configure

After finishing calibration, users can save the calibration results in two ways:

1. Click the "**Save Cfg**" button 

on the menu bar, it will save the full configure including the changed or unchanged items.
2. Click the "**Dump Cfg**" button provided on the current page, it will only save the parameters within the current page. Users can manually revise the sensor configuration file according to the output parameters.

Chapter 3

Function Manual

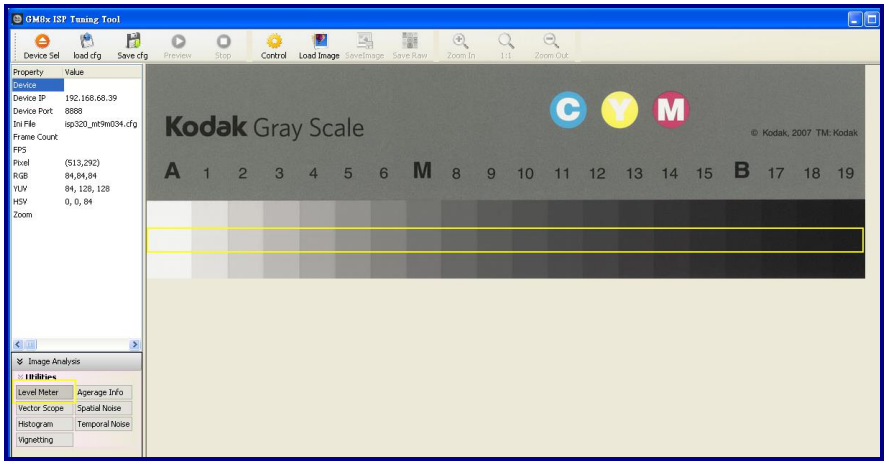
This chapter contains the following sections:

3.1 Image Analysis

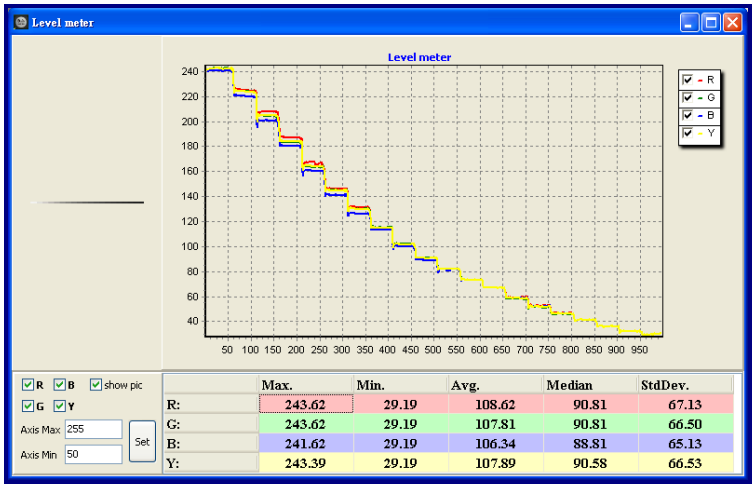
GM_IspTool provide several useful image analysis tools for users to check the image quality. To use these utilities, users should mark ROI first and then click the "function" button. The image analysis results will be displayed on the popped windows. If the image was changed or ROI was re-marked, the analysis results will be automatically refreshed.

3.1.1 Level Meter

This function was used to analyze the density level of the gray scale. To use "Level Meter", users should first draw **ROI** on the target image; then, click the "**Level Meter**" button on the **Image Analysis** panel.

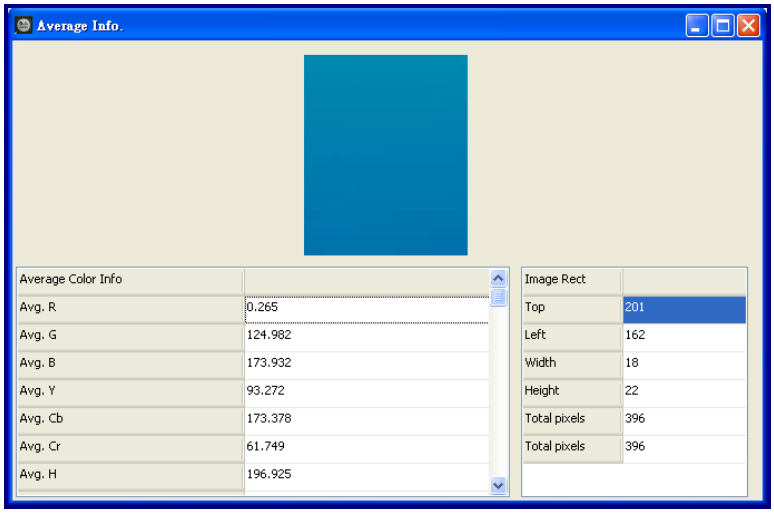


Level Meter chart will be shown as the following:



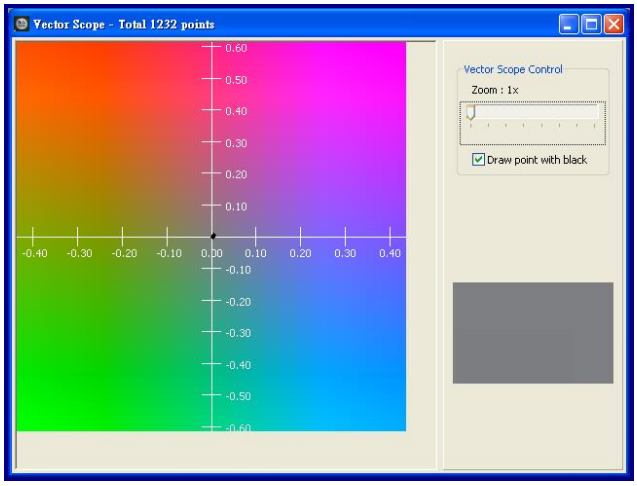
3.1.2 Average Info

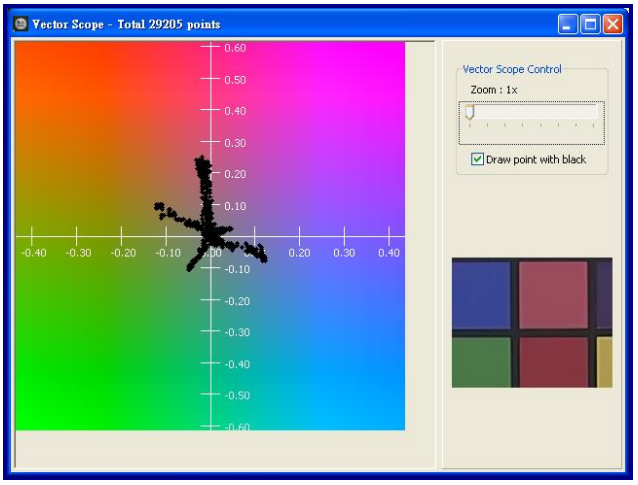
This function helps users to get the average color information within ROI. The color information includes (R, G, B), (Y, Cb, Cr), (H, S, V), and so on.



3.1.3 Vector Scope

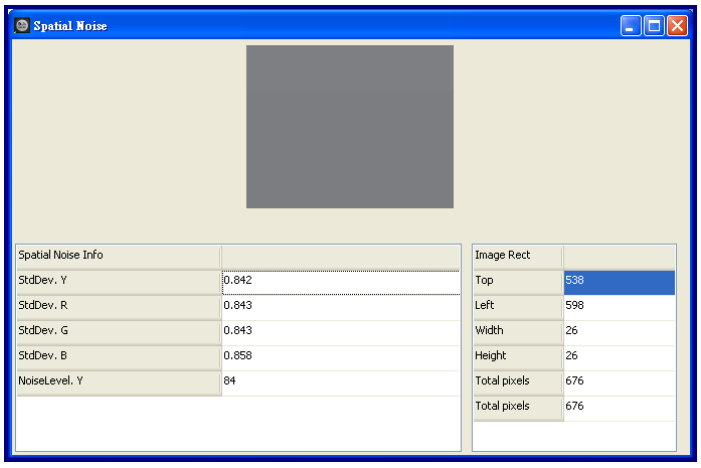
The Vector Scope function helps users to check the AWB results. If AWB is correct, the sampled pixels will be located on the central area (As the left picture). Otherwise, the pixels will apart from the center (As right picture).



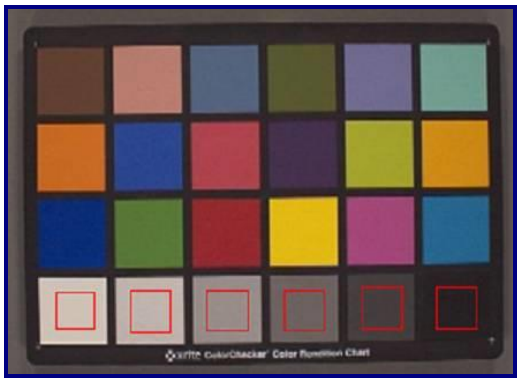


3.1.4 Spatial Noise

This function helps users to measure the noise level of the image by calculating the standard deviation.



A reference minimum requirement for the spatial noise is :



δmax < 2.7	Light intensity: 30lux Color temperature: 3000k and 5000k
δmax < 1.7	Light intensity: 300lux Color temperature: 3000k and 5000k

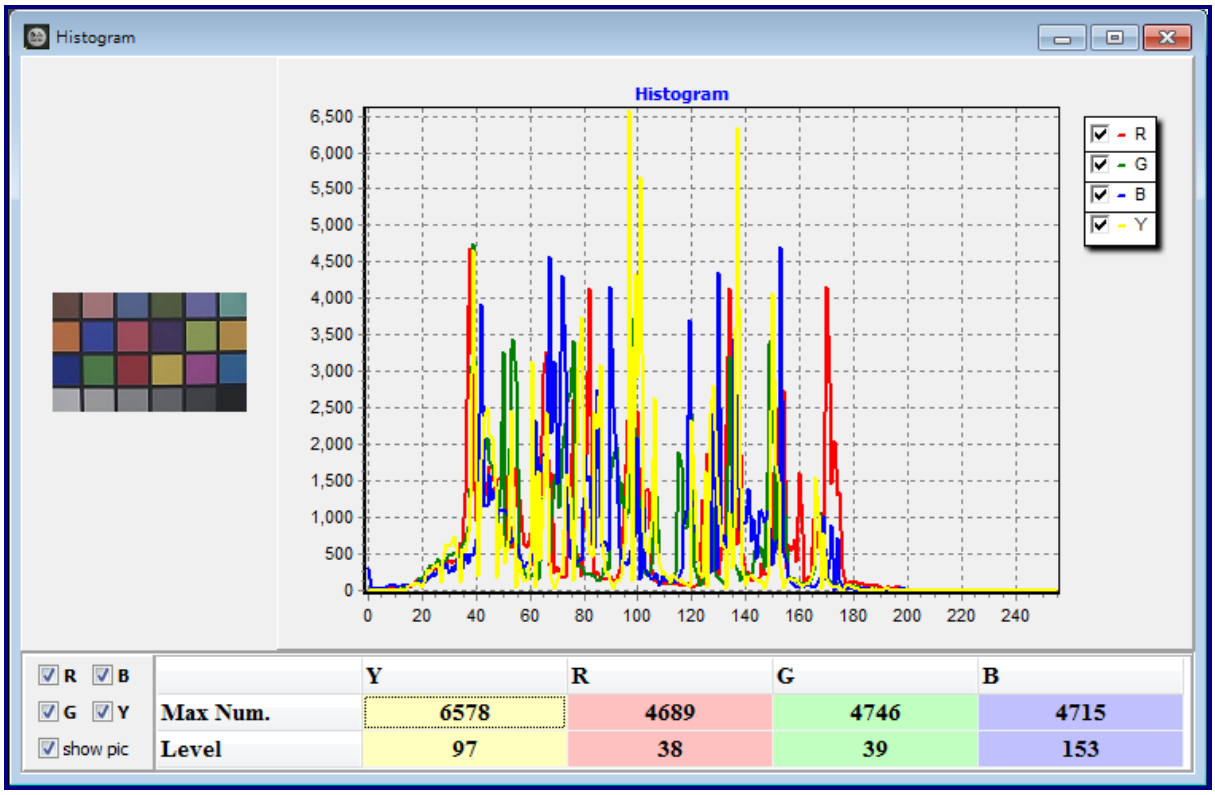
(Skype Hardware Certification Specification for allSkype Video Devices V5.0)

Where standard deviation $\sigma = \sqrt{\frac{1}{M \cdot N - 1} \sum_{i=1}^{N} \sum_{j=1}^{M} \left(x_{ij} - \overline{P}\right)^2}$

δmax is the max. standard deviation of the six grayscale patches.

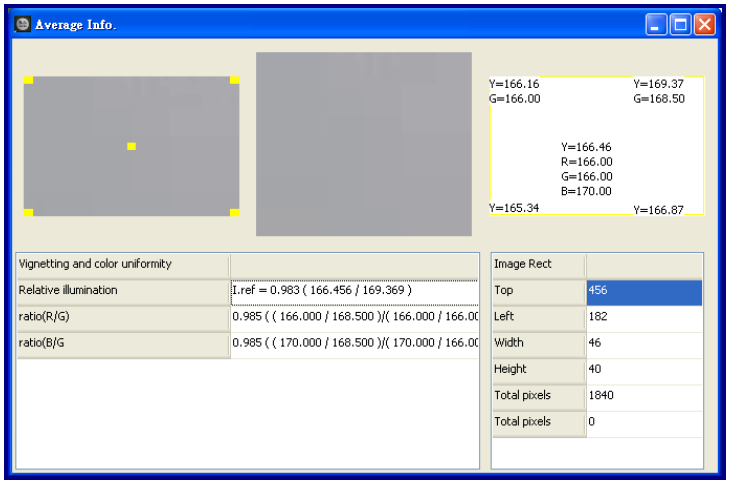
3.1.5 Histogram

This function draws the histogram graph of ROI. Usually, ROI should be set to full image to get the full histogram information of an image.

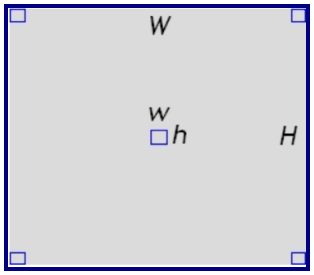


3.1.6 Vignetting

This function helps users to check if the frame will not be significantly darker nor of different colors to the center. On the other hand, users should check the color uniformity after the lens shading correction.



A reference minimum requirement for light fall off is:



$0.9 \le I_{rel} \le 1.4$	Light intensity: 30lux Color temperature: 3000k and 5000k
$0.9 \le I_{rel} \le 1.4$	Light intensity: 300lux Color temperature: 3000k and 5000k

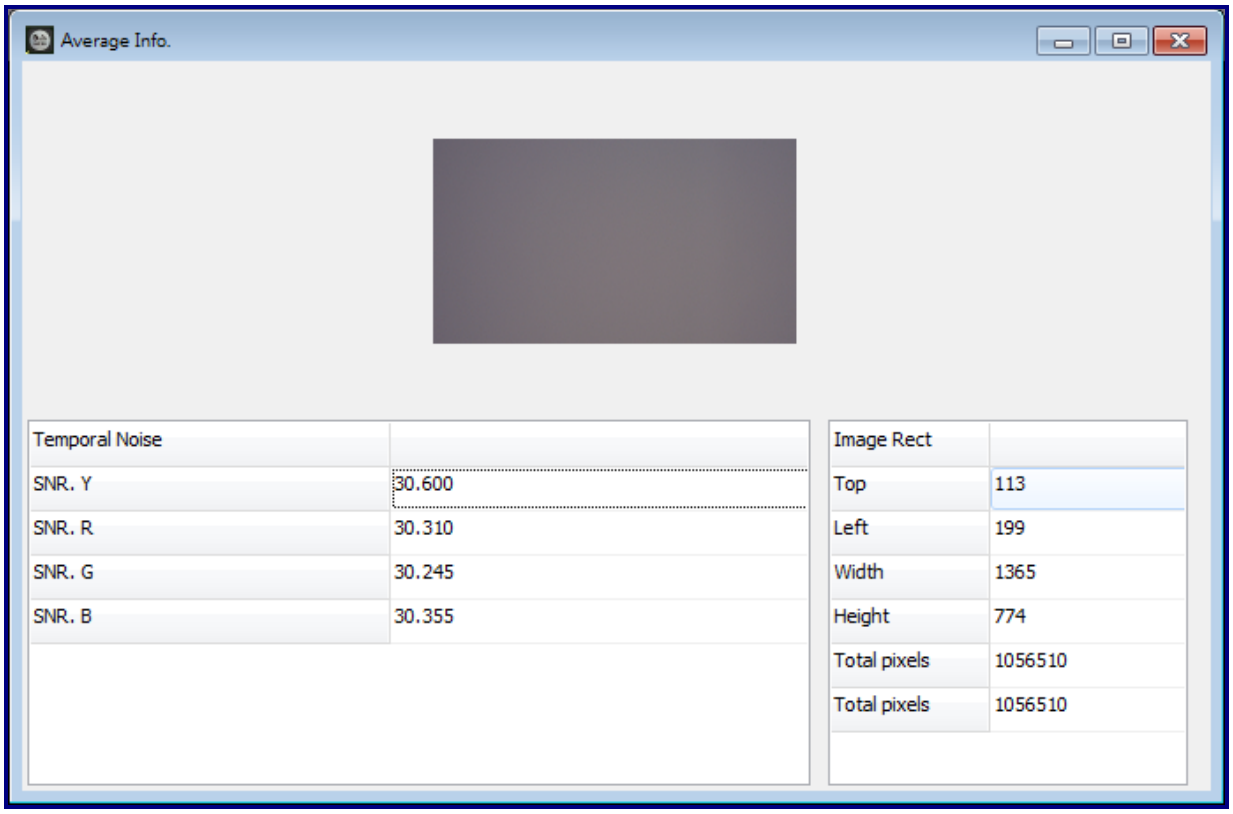
(Skype Hardware Certification Specification for allSkype Video Devices V5.0)

Where relative illumination $I_{rel} = \frac{P_{center}}{P_{corner}(worstcase)}$

and $\boldsymbol{P_{center}}$ is the average grayscale pixel value of the center of an image and $\boldsymbol{P_{corner}}$ is the average grayscale pixel value of one of the corners.

3.1.7 Temporal Noise

This function helps users to measure the temporal noise level of the image by calculating SNR.



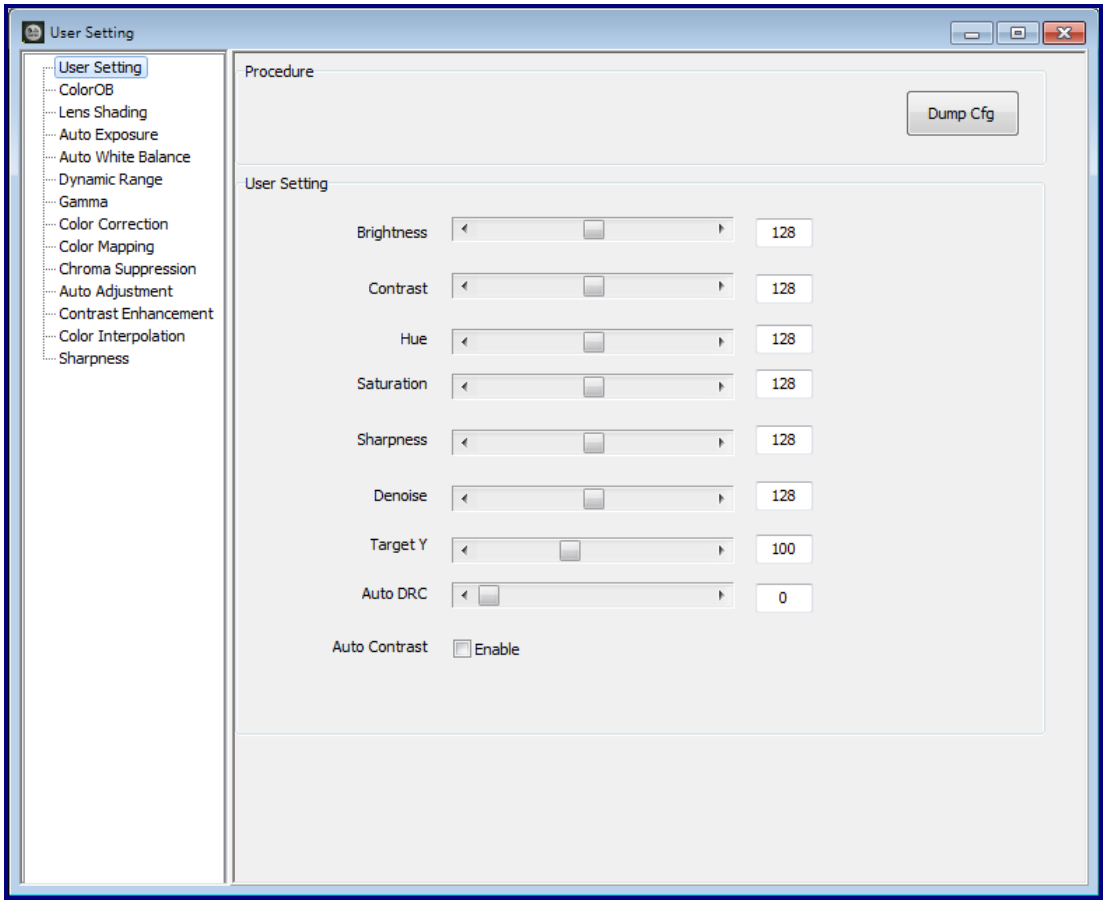
3.2 Image Calibration

Grain Media camera device integrates one high performance ISP, which contains the complex modules for sensor/lens calibration and image adjustment. **GM_IspTool** is designed for simplifying and fastening the tuning procedure.

3.2.1 User Setting

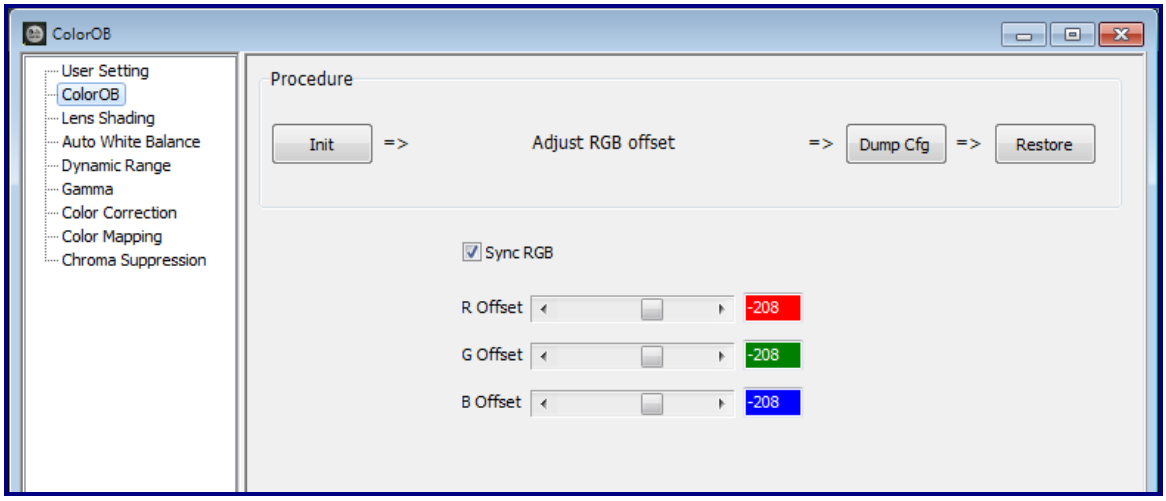
This page provides the interface for users to set the general preferred settings:

- Brightness: Adjust the image brightness level
- Contrast: Adjust the image contrast level
- Hue: Adjust the image hue level
- Saturation: Adjust the image color saturation level
- Sharpness: Adjust the image sharpness level
- Denoise: Adjust the image noise reduction level
- Target Y: Adjust the AE target brightness
- Auto DRC: Adjust the Auto DRC strength
- Auto Contrast: Enable or disable the Auto Contrast
- **DumpCfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on **Main Menu** to save the full configuration file.


User Setting
User Setting
ColorOB
Lens Shading
Auto Exposure
Auto White Balance
Dynamic Range
Gamma
Color Correction
Color Mapping
Chroma Suppression
Auto Adjustment
Contrast Enhancement
Color Interpolation
Sharpness
Procedure
Dump Cfg
User Setting
Brightness
128
Contrast
128
Hue
128
Saturation
128
Sharpness
128
Denoise
128
Target Y
100
Auto DRC
0
Auto Contrast
Enable

3.2.2 Color OB

This page corrects the black level of the sensor data.



1. **Init**: Click on this button, it will disable those modules which will affect the calibration accuracy to confirm the correct results.
2. **Adjust RGB offset**: Start to set R, G, and B Offsets to ISP
3. **DumpCfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on **Main Menu** to save the full configuration file.
4. **Restore**: Re-enable those modules which were disabled at the **Init** step

It is recommended checking the setting of the sensor black level before performing the calibration. The output black level usually could be found in the sensor data sheet. For example, the black level is called **pedestal data** in Aptina sensor and is called **black level value** in Sony sensor. This value should be close to the black level output by the sensor.

MT9M034

12318 R0x301E	15:0	0x00A8	data_pedestal_ (R/W)
	Constant offset that is added to pixel values at the end of datapath (after all corrections).		

SONY IMX136LQJ

Address		Bit	Register Name	Description	Default value after reset		Reflection timing
4-wire	I2c				By register	By address	
0Ah	300Ah	0	BLKLEVEL[8:0]	LSB Black level offset value setting	03Ch	3Ch	V
		1					
		2					
		3					
		4					
		5					

SONY

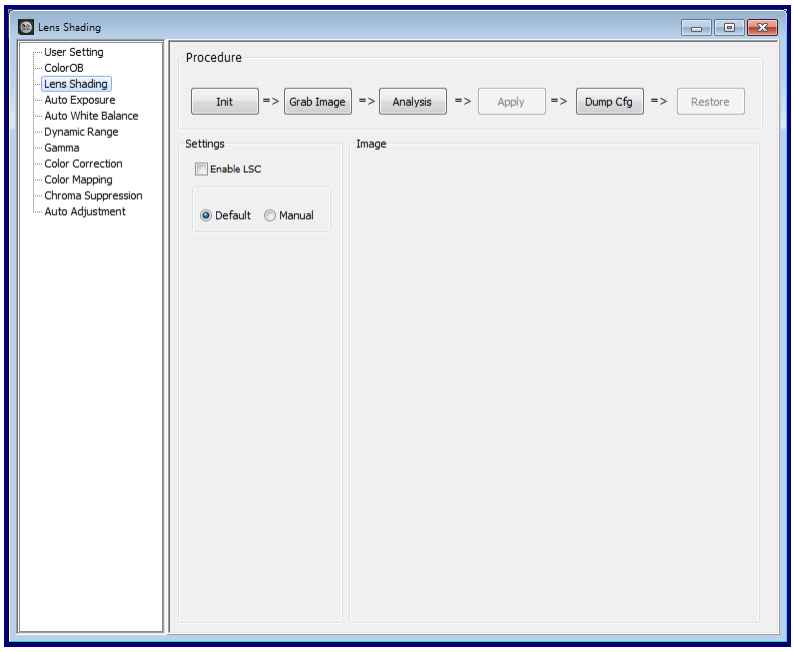
TENTATIVE

IMX138LQJ-C

Address		Bit	Register Name	Description	Default value after reset		Reflection timing
4-wire	I^2C				By register	By address	
0Ah	300Ah	0	BLKLEVEL [8:0]	LSB Black level offset value setting	03Ch	3Ch	V
		1					
		2					
		3					
		4					
		5					
		6					
		7					

3.2.3 Lens Shading

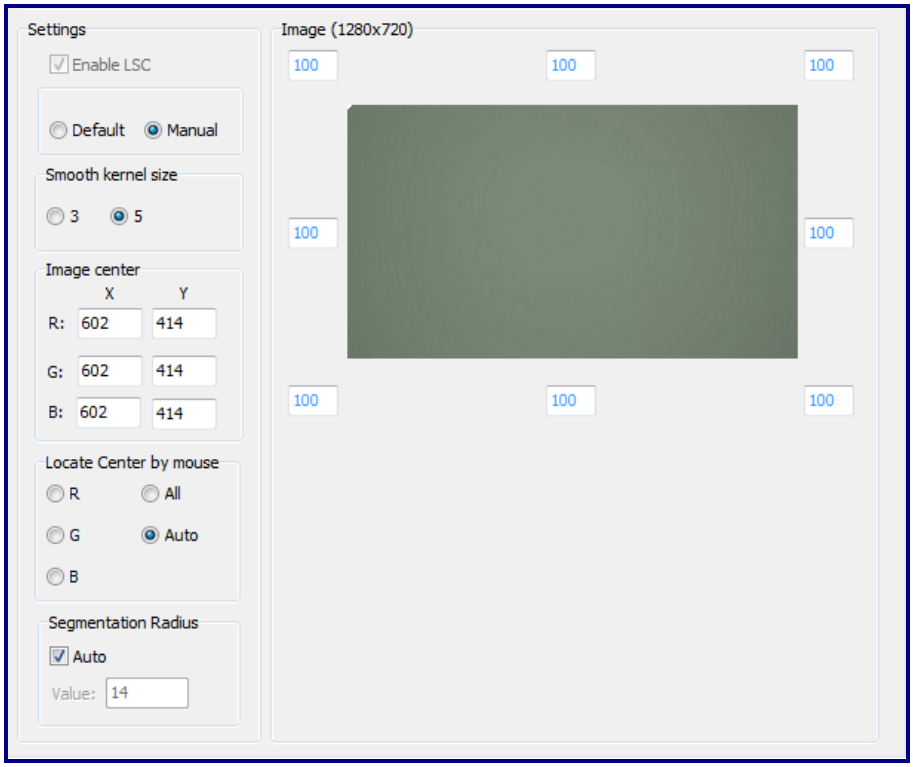
This page provides the lens shading correction tool, which helps users to auto-generate the parameters for the Grain Media ISP lens shadding correction module.



To perform the lens shading correction, users can follow the calibration flow indicated on the user interface. These processes are explained as follows:

1. **Init**: Click on this button, it will disable those modules which will affect the calibration accuracy to confirm the correct results.
2. **Grab Image**: A source image is needed as the calibration reference. This picture should contain nothing except for the white pattern under uniform light source. If the Grain Media camera device was connected, users can click the "Grab Image" button to directly grab the image from the device.
3. **Analysis**: Start auto calibration and generate parameters
4. **Apply**: Apply the result parameters to ISP
5. **DumpCfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on **Main Menu** to save the full configuration file.
6. **Restore**: Re-enable those modules which were disabled at the **Init** step

In the **Setting** group, usesr can choose "Manual" setting to set more professional adjustments if the calibration result by the default setting is not satisfied.



- **Enable LSC**: The option is uesed to enable or disable Lens shading module in ISP. The checkbox will be disable after execute **Init**, and enable after **Restore**.
- **Smooth kernel Size**: Adjust the smooth level in the calibration algorithm
- **Image Center**: If the calibrated lens center is not accurate. Users can manually set the cooridinates of the lens center of the seperated color channels.
- **Locate center by mouse**: Users also can manually set the the coordinates by clicking on the preview image or Auto option.
- **Segmentation Radius**: The value means sampling segement of each line in 2's order and please reference chapter "Lens Shading Correction" of ISP SDK for detail definition. Users can manually set the the value with unchecked "Auto", or set the value by algorithm with cheched "Auto".
- **Image (width x height) and Corner Correction %:** Preview the grab image and set the maximum light fall off ratio. If the lens contain serious lens shadding effect, decreasing the value can reduce the noise on cornor area but the vignetting effect may appears. After executing "**Analysis"** button, the simulated result of the lens shading will be shown under "Image".

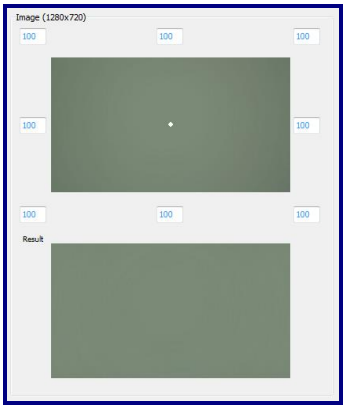
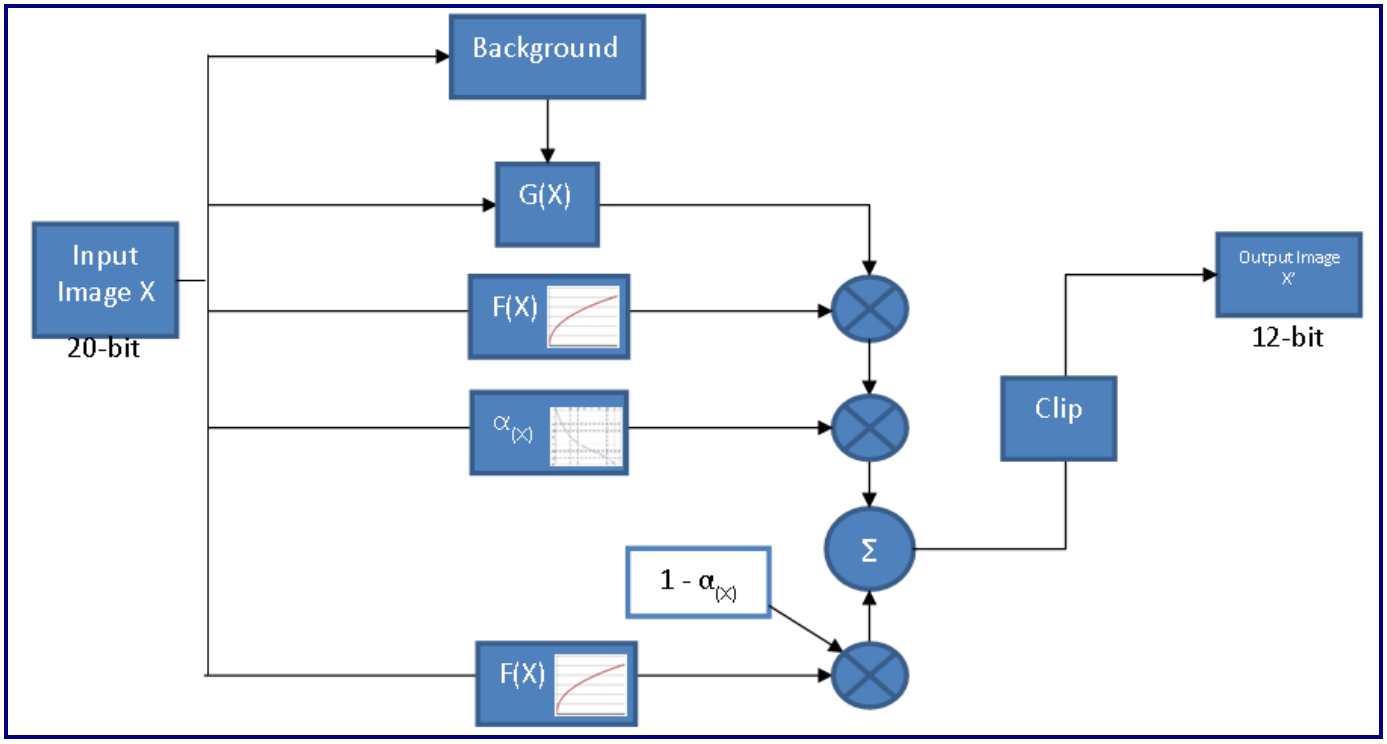


Image (1280x720)
100
100
100
100
100
100
100
100
100
Result

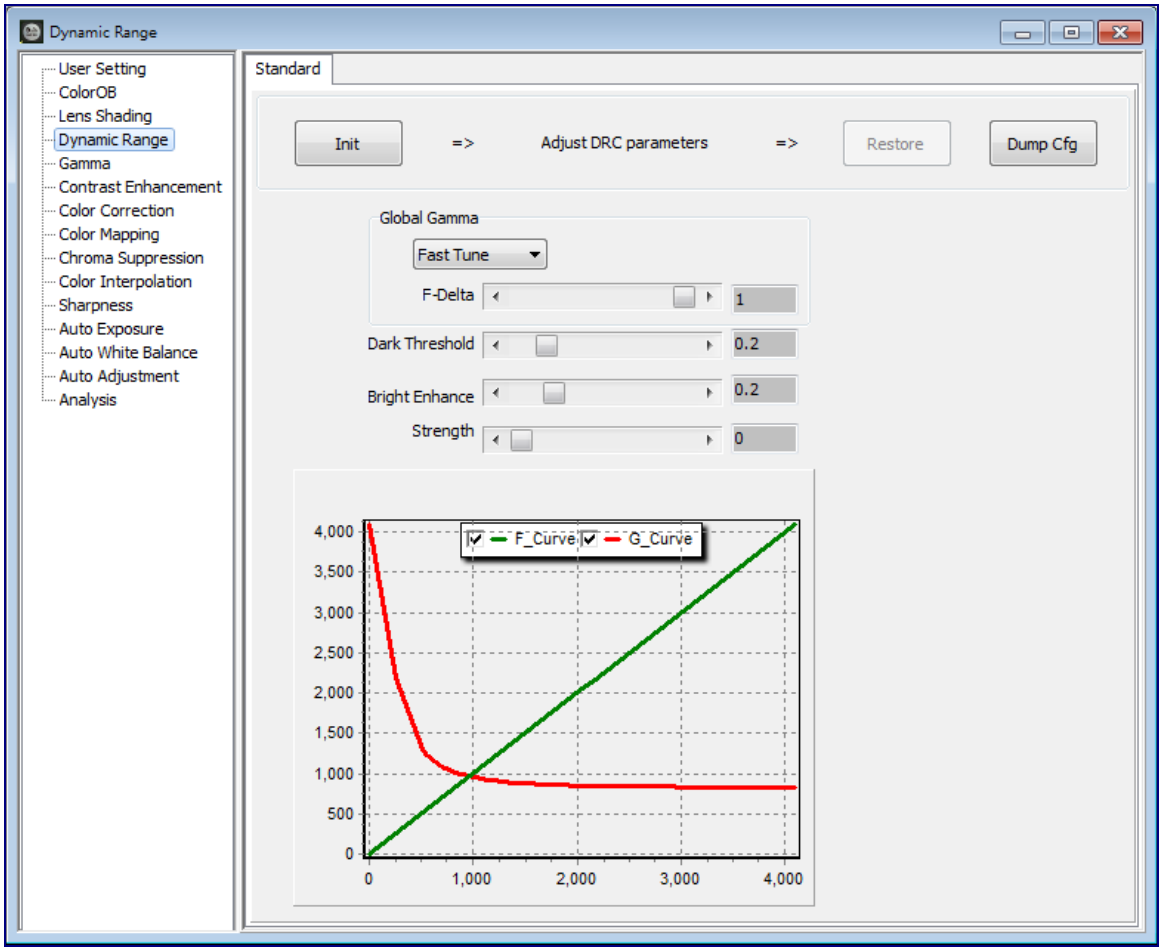
3.2.4 Dynamic Range

Grain Media DRC is a pixel based tone level control which compresses the dynamic range from high bit width to low bit width. It supports the maximum 20-bit input WDR data and finally outputs 12-bit processed image data.

The entire image is divided into several blocks for the background information statistic. The DRC algorithm calculates out the amplifier $\mathbf{G_{(x)}}$ of current pixel by measuring the intensity relationship between the current pixel and the background information. The input image data separates into two paths. One is transformed by a global tone mapping curve ($\mathbf{F_{(x)}}$), the other is multiplied by amplifier $\mathbf{G_{(x)}}$. Finally, the two data paths are blended according to the weighting function $\mathbf{A_{(x)}}$.



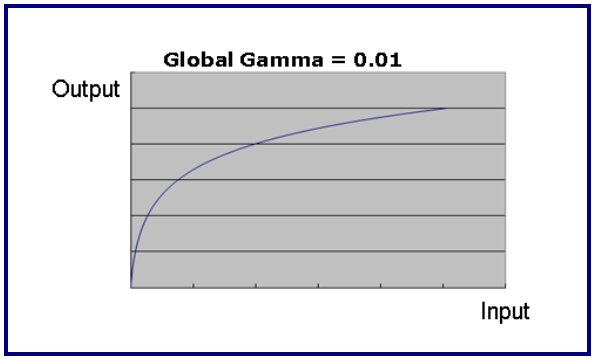
This page is used to calibrate and output the parameters of the Grain Media ISP Dynamic Range module. The procedures are explained as follows.



1. **Init**: This button is used to disable those modules, which will affect the calibration accuracy to confirm the correct results.
2. **Adjust DRC paramters**: Start to set paramters
3. **Restore:** Re-enable those modules which were disabled at the **Init** step.
4. **DumpCfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on **Main Menu** to save the full configuration file.

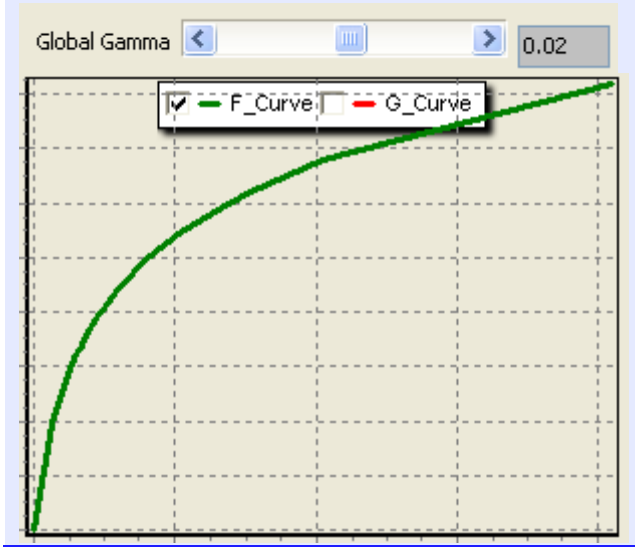
Strength : Adjust the strength of DRC effect. Please note that, this strength value is only for real time checking DRC performance and will not be saved into ISP configuration file. For product stage, please use IOCTL command to manually control the DRC strength.

Global Gamma: Users could use two operations to adjust the global tone mapping curve F(x). One is Fast Tune by adjust F-Delta. This value is recommended setting to 1 for linear sensor. For the WDR sensor, this value should be in a range of between 0.01 and 0.0001 depending on the bit width of the sensor output data.

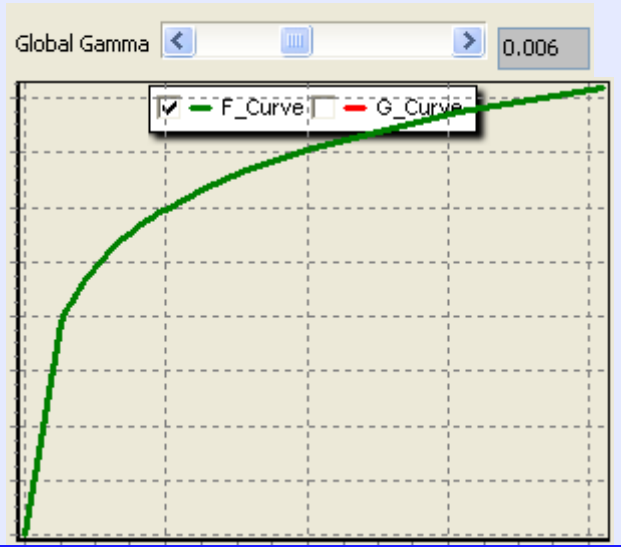


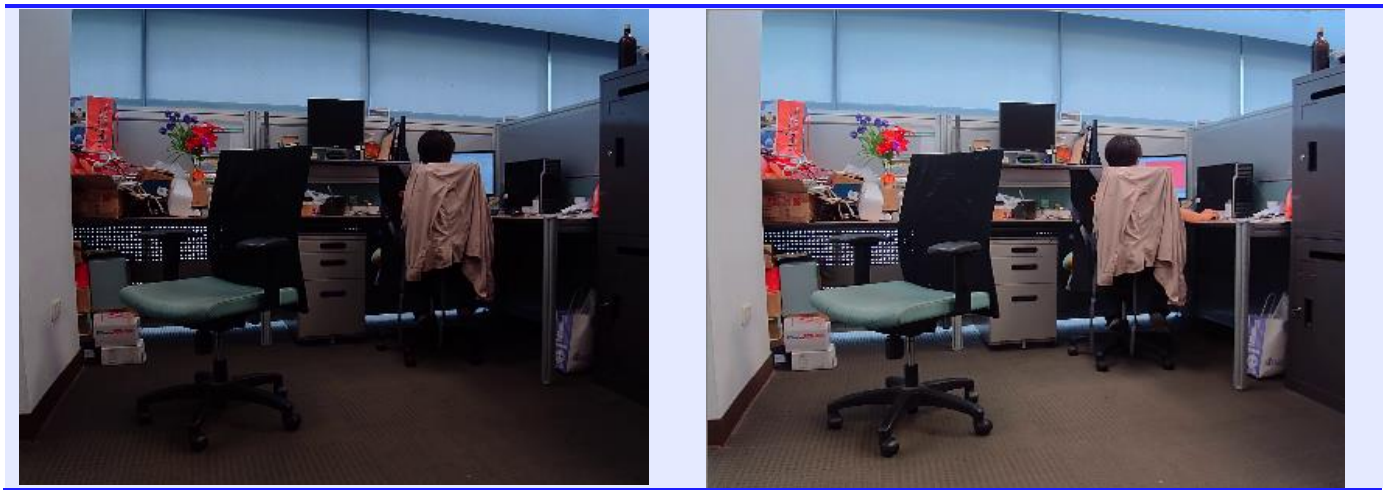
Example: AR0331 WDR mode

F = 0.02

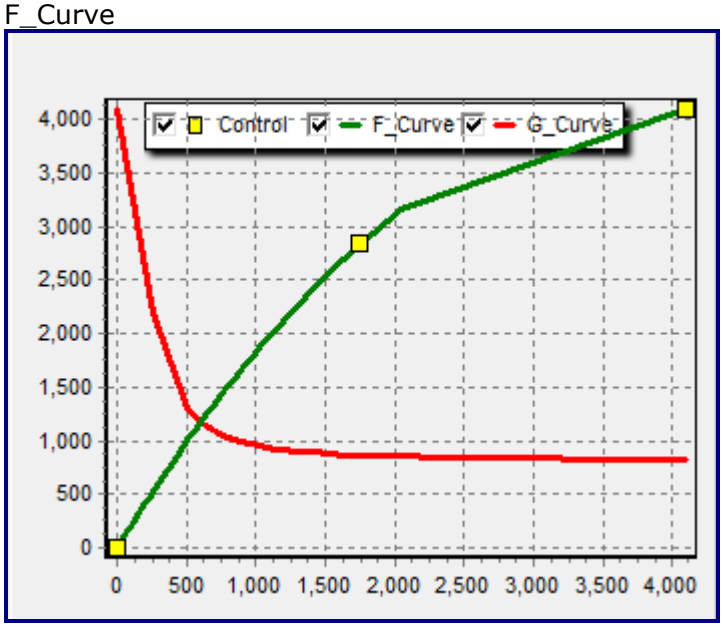


F = 0.006





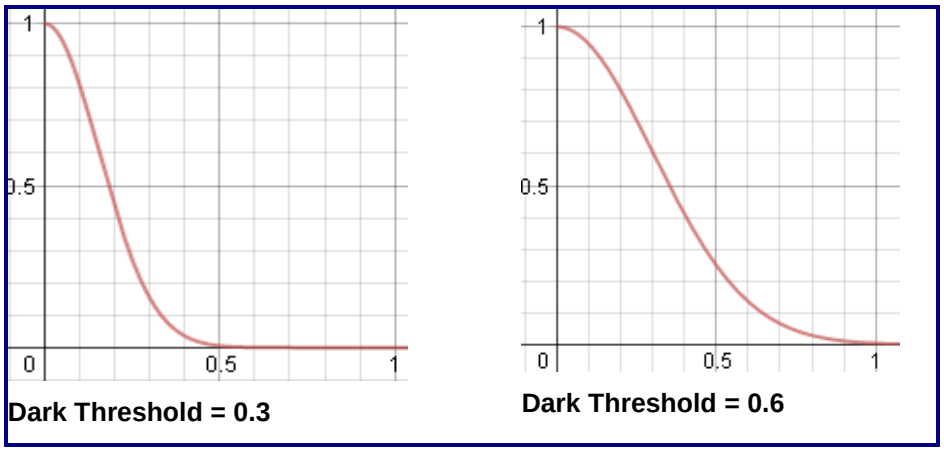
The other operation is Manual Mode. Users can also click on F_curve to create the yellow control points. Or drag one control point to another to delete. Draging and droping these points can create a more flexible F_Curve



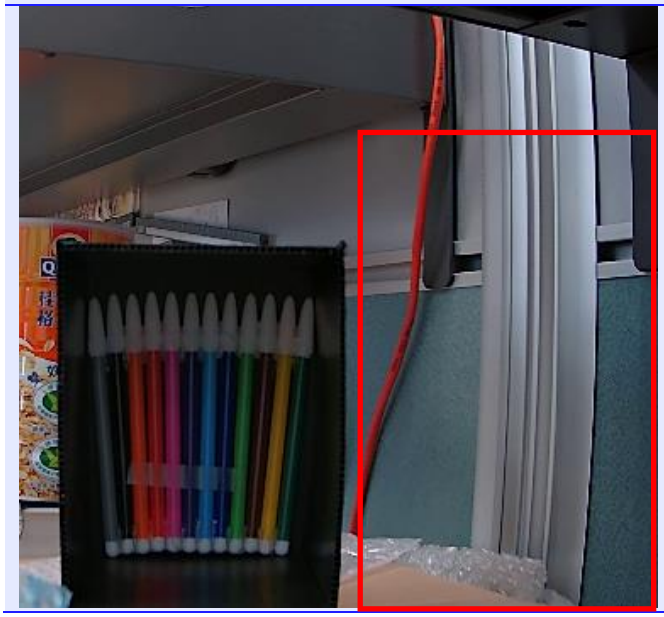
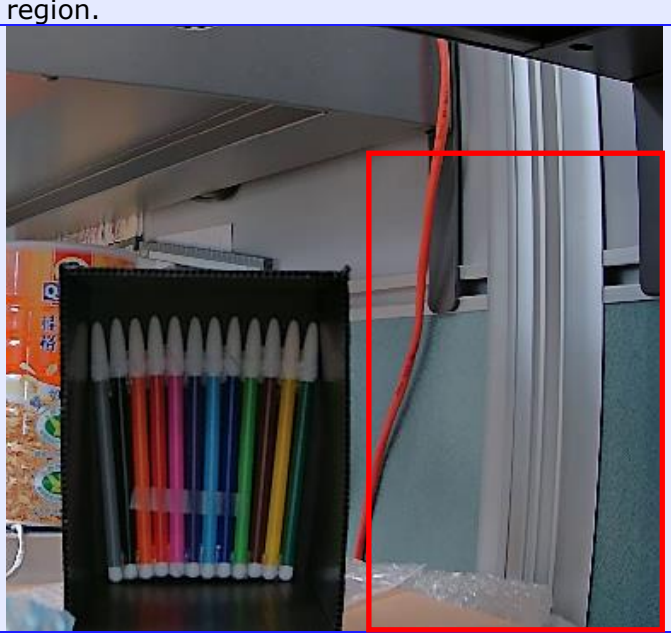
Dark Threshold: A(x) is a weighting curve, which decides the blending ration between the original data and DRC data. As shown in following figures, the A(x) curve is similar to Gaussian distribution curve, which gives large weighting for the dark region and gives small weighting for the bright region.

Please note that, the "**strength"** parameter controls the final strength of the DRC effect, so before adjusting the parameter please set "**strength"** to 128 or higher value.

The "Dark Threshold" acts like δ.

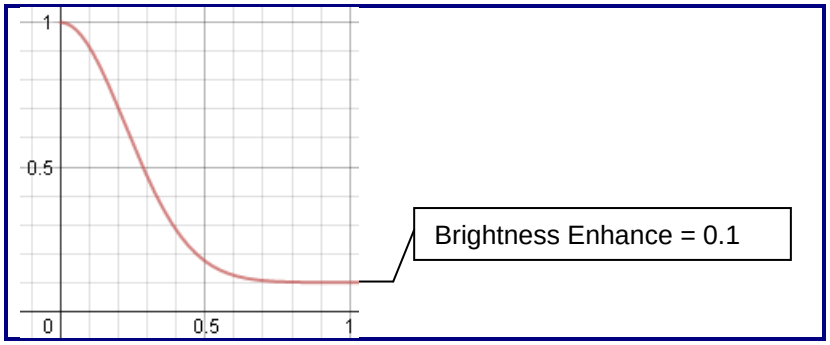


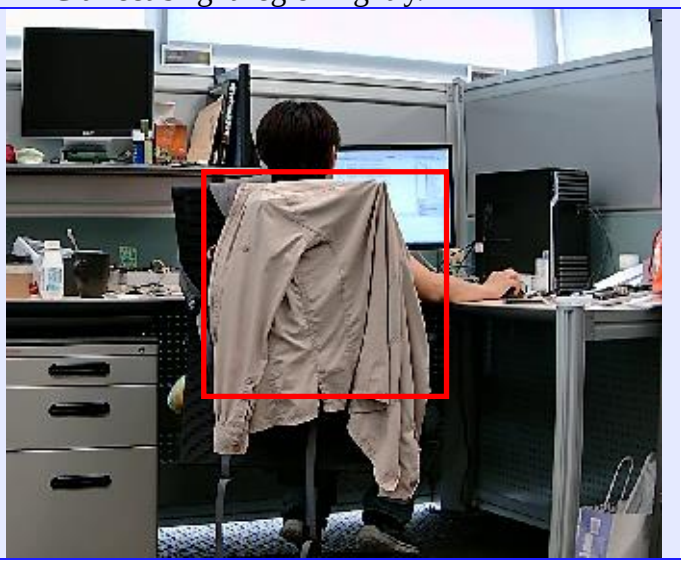
Example: Linear Sensor

Dark Threshold = 0.4 DRC only affect the dark region	**Dark Threshold = 1** DRC affect both dark region and middle dark region.
	

Bright Enhance: Set the minimum weighting for DRC data.

Please note that, the "**strength"** parameter controls the final strength of the DRC effect, so before adjusting the parameter please set "**strength"** to 128 or higher value.



Bright Enhance = 0 DRC only affect dark region	**Bright Enhance = 0.5** DRC affect bright region lightly.
	

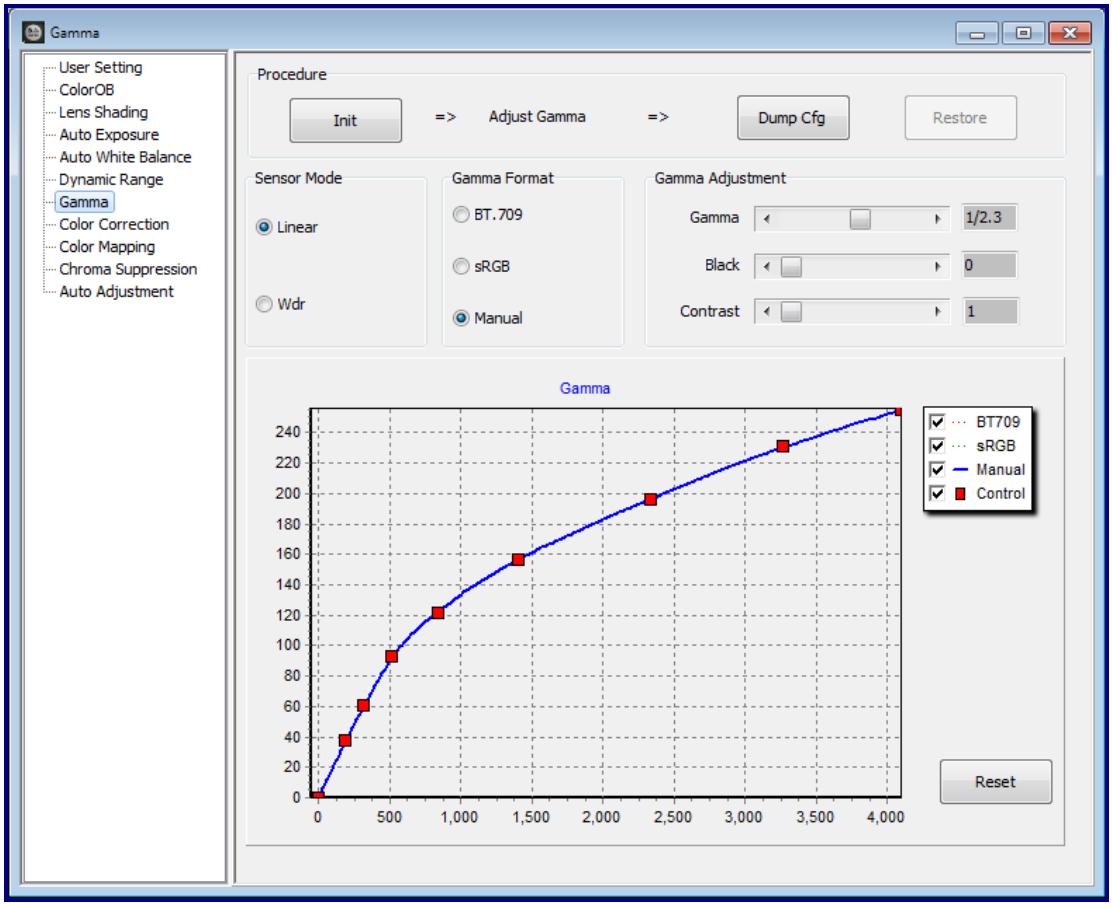
3.2.5 Gamma Adjustment

This page is for gamma adjustment. Since Grain Media ISP supports both general linear sensor and WDR sensor, and ISP firmware supports dynamic mode changing. Before adjustment, users should first confirm the current sensor mode.

1. **Init**: This button is used to disable those modules, which will affect the calibration accuracy to confirm the correct results.
2. **Adjust Gamma**: Start to adjust by setting Sensor Mode, Gamma Format, and Gamma Adjustment.
3. **Dump Cfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on **Main Menu** to save the full configuration file.
4. **Restore**: Re-enable those modules which were disabled at the **Init** step.

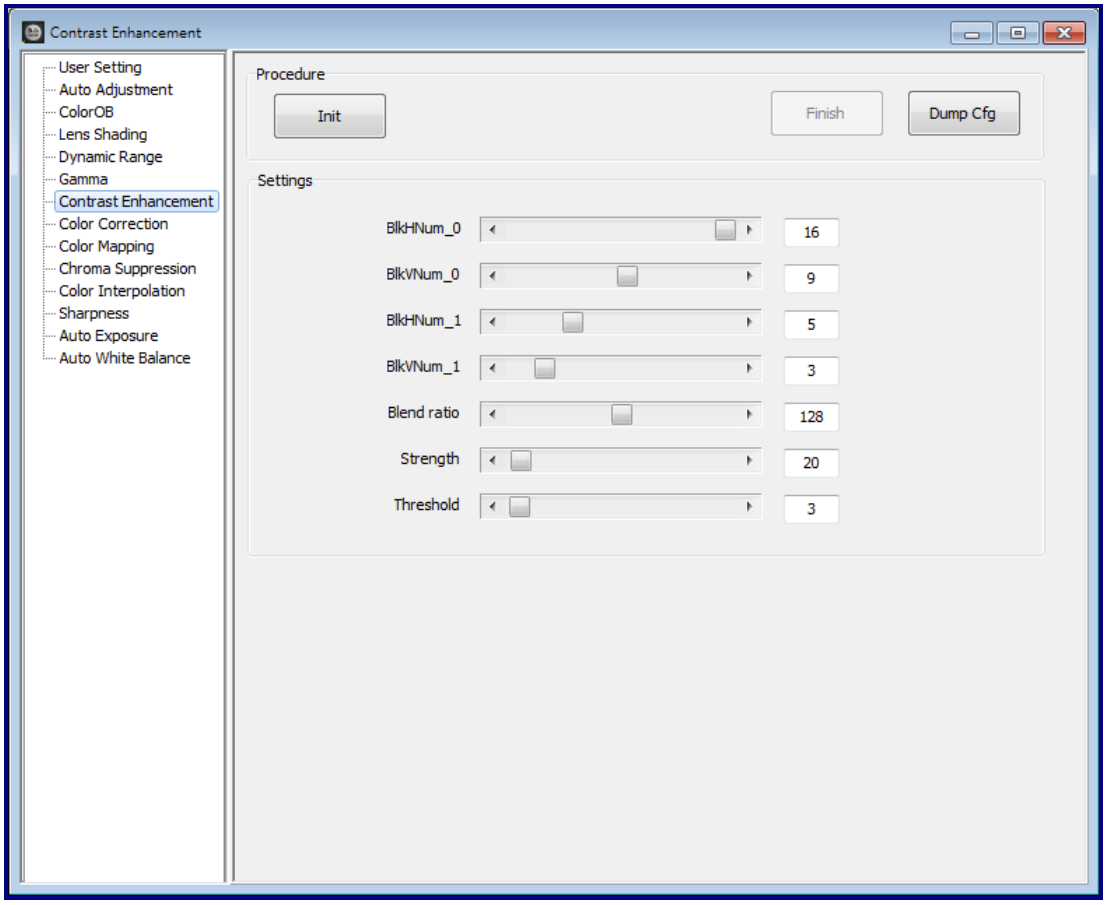
GM_IspTool provides two standard gamma formats. One is the BT.709 format, and another is the sRGB format. Beside these two formats, users can select the manual mode and adjust the "Gamma Adjustment" scrollbars to achieve the prefered gamma curve.

In the manual gamma mode, users can also click on the gamma curve to create the control points. Or drag one control point to another to delete. Draging and droping these points can create a more flexible gamma curve.


Gamma
User Setting
ColorOB
Lens Shading
Auto Exposure
Auto White Balance
Dynamic Range
Gamma
Color Correction
Color Mapping
Chroma Suppression
Auto Adjustment
Procedure
Init
=>
Adjust Gamma
=>
Dump Cfg
Restore
Sensor Mode
Linear
Wdr
Gamma Format
BT.709
sRGB
Manual
Gamma Adjustment
Gamma
1/2.3
Black
0
Contrast
1
Gamma
240
220
200
180
160
140
120
100
80
60
40
20
0
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
BT709
sRGB
Manual
Control
Reset

3.2.6 Contrast Enhancement

This page is used to calibrate and output the parameters of the Grain Media ISP Contrast Enhancement module.

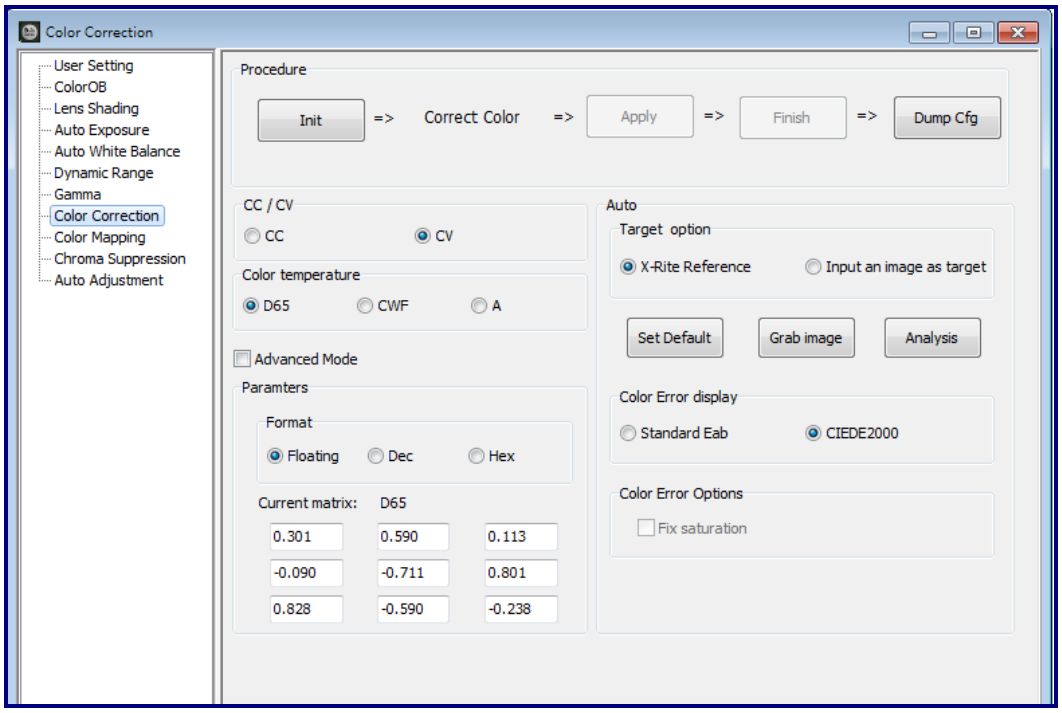


1. **Init**: This button will disable those modules which will affect the calibration accuracy to confirm the correct results.
2. **Settings**: Adjust by setting EdgeDth, FreqTh, and FreqBlend.
3. **Finish:** Re-enable those modules which were disabled by the **Init** step.
4. **DumpCfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on Main Menu to save the full configuration file.

3.2.7 Color Correction

This page is used to calibrate and output the parameters of the Grain Media ISP Color Correction module for the color accuracy enhancement.

The procedures are explained as follows:

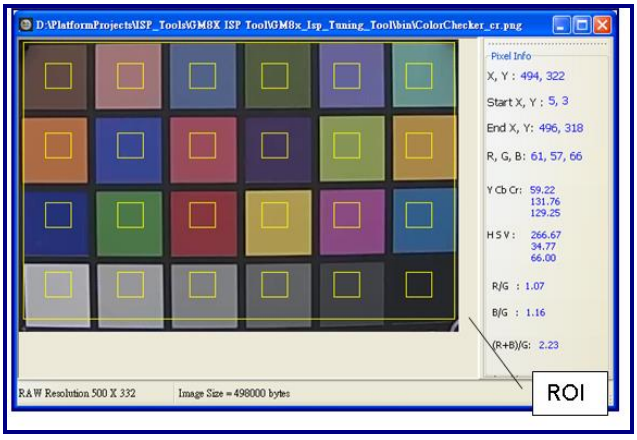


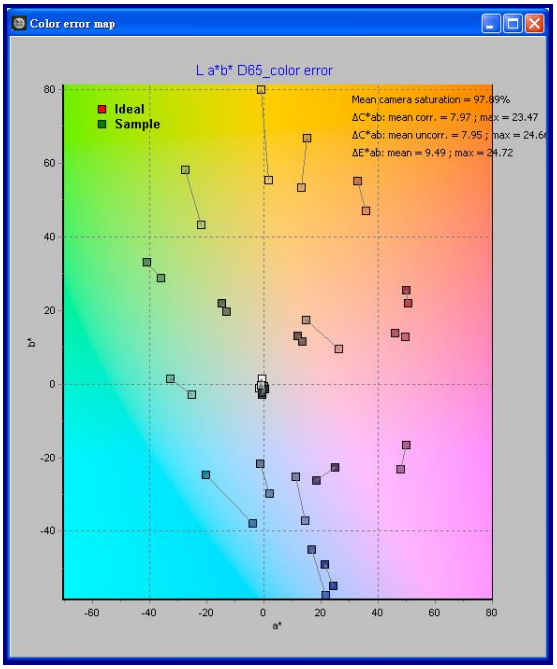
1. **Init**: This button will disable those modules which will affect the calibration accuracy to confirm the correct results.
2. **Correct Color**:
   - **CC/CV**: Select CC or CV as the target matrix to do calibration, where CC indicates the RGB to RGB matrix and CV indicates the RGB to YUV matris. When users change this option, the following calibraion steps should be done again.
   - **Color temperature**:The button in the light source group (A, CWF, D65) indicates the target color temperture. Please sequentially set the color temperature and start to generate paramters by the following steps.

(1) **Advanced Mode**: When the button is checked, users can skip the "Auto" step and manually adjust the parameters.

(2) **Auto**: Select "Target option" and this tool provides the standard X-Rite reference value (ColorChecker) as the target color. Set Default to initialize color. Grab Image to grab the images according to the corresponding light source and mark ROI on the grabbed/loaded image. This tool will then measure the color information as the calibration database. Analysis to start the auto calibration and generate parameters. After calibration has been done, a color error map graph will be popped up to show the La*b* color error value. Also, apply the parameters to ISP to review the result.

User can also load a prefered color checher image from a prepared file as the target color by select "Input an image as target".





A reference minimum requirement for color accuracy is:

$\Delta C^*_{avg-abcorr} \leq 20$	Light intensity: 30lux Color temperature: 3000k and 5000k
$\Delta C^*_{avg-abcorr} \leq 13$	Light intensity: 300lux Color temperature: 3000k and 5000k

(Skype Hardware Certification Specification for allSkype Video Devices V5.0)

$\Delta C^*_{avg-abcorr}$ denotes the average chroma compensated color error (Average of all 24 patches).

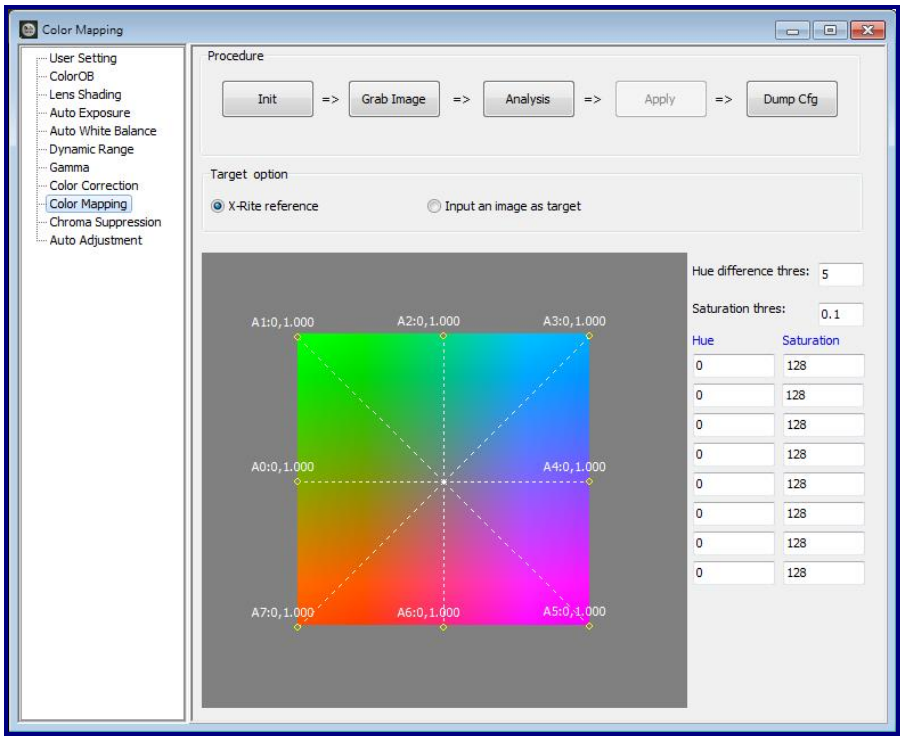
- Paramters: User can also manually adjust the ouput parameters and switch the paramters format. Also, apply the parameter to ISP to review the results.

3. **Apply**: After three color temperaures (D65, CWF, and A lights) are calibrated, users can click the "Apply" button to apply all CC/CV settings to the device, and click the "Finish" button to check the color correction results.
4. **Finish**: Re-enable those modules which were disabled by the **Init** step.
5. **DumpCfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on Main Menu to save the full configuration file.

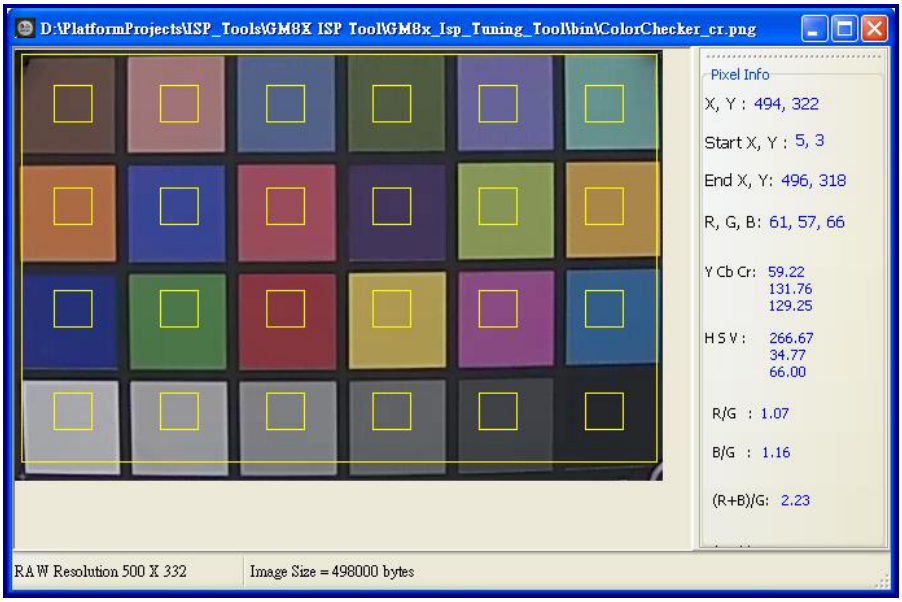
3.2.8 Color Mapping

This page is used to calibrate and output the parameters of the Grain Media ISP Color Mapping module for the color accuracy enhancement.

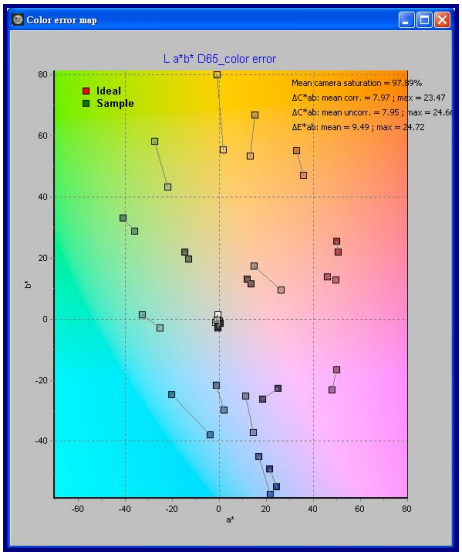
The procedures are explained as follows:

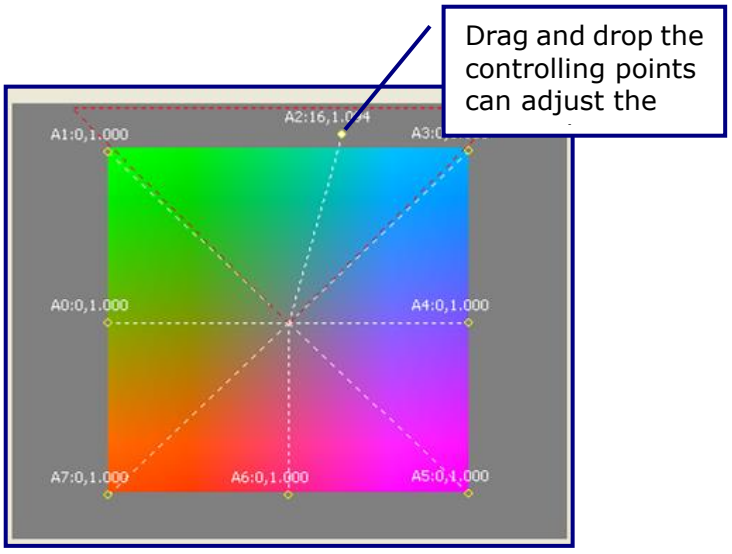


1. Select "Target option": This tool provides the standard X-Rite reference value as the target color. Users can also load a prefered color checker image as the target color.
2. **Init**: This button will disable those modules which will affect the calibration accuracy to confirm the correct results.
3. **Grab Image**:
   - Use Chart: X-Rite ColorChecker
   - Light Source: D65



4. **Analysis**: Start the auto calibration and generate parameters. When calibration was done, a color error map graph will be popped up to show the La*b* color error value (Left picture). Users can also manually adjust the output parameters.



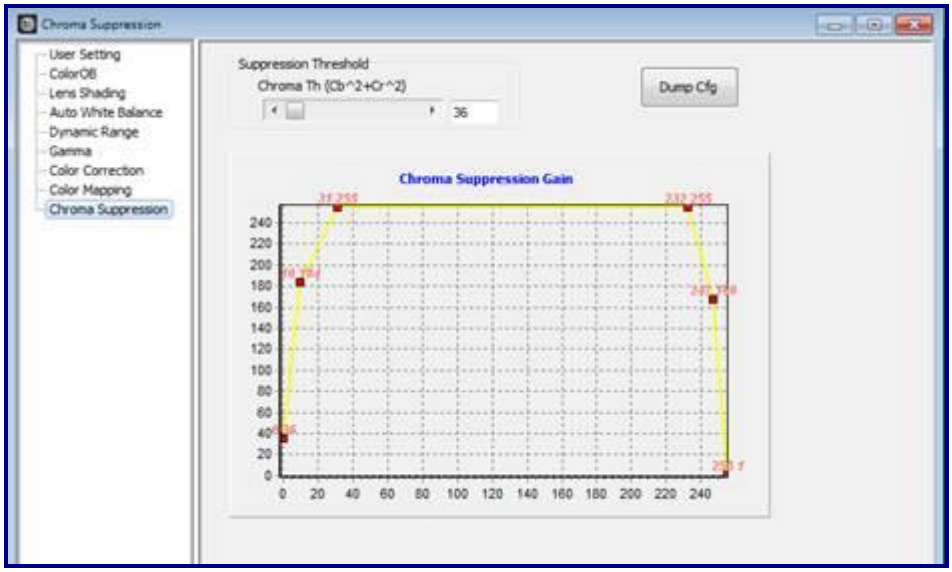


5. **Apply**: Apply the result parameters to ISP

6. **DumpCfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on Main Menu to save the full configuration file.

3.2.9 Chroma Suppression

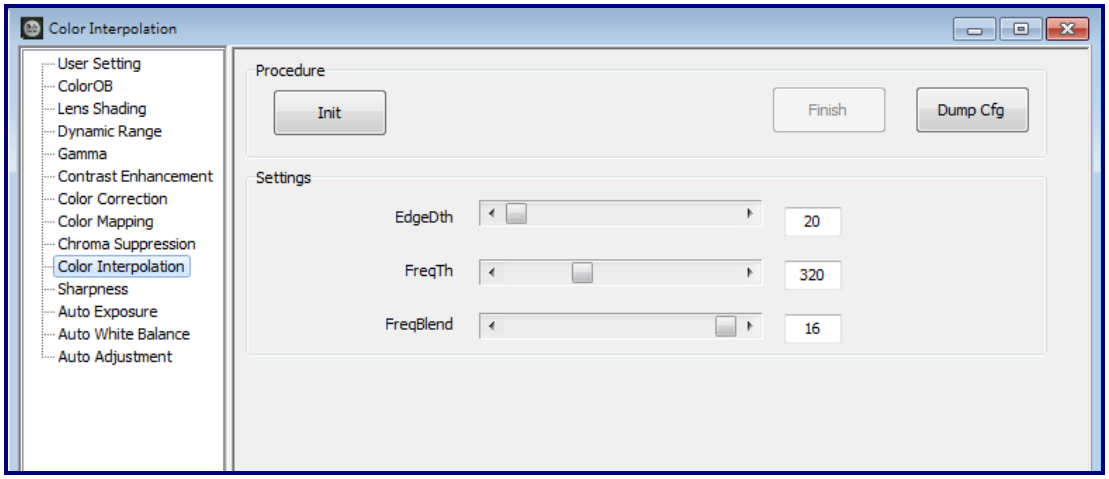
This page is used to calibrate and output the parameters of the Grain Media ISP Chroma Suppression module. The procedures are explained as follows.



1. **Suppression Threshold**: Users can immediately adjust the threshold parameter.
2. **Chroma Suppression Gain**: Users can drag and drop the red controlling points to adjust the parameter immediately.
3. **Global Gamma**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on Main Menu to save the full configuration file.

3.2.10 Color Interpolation

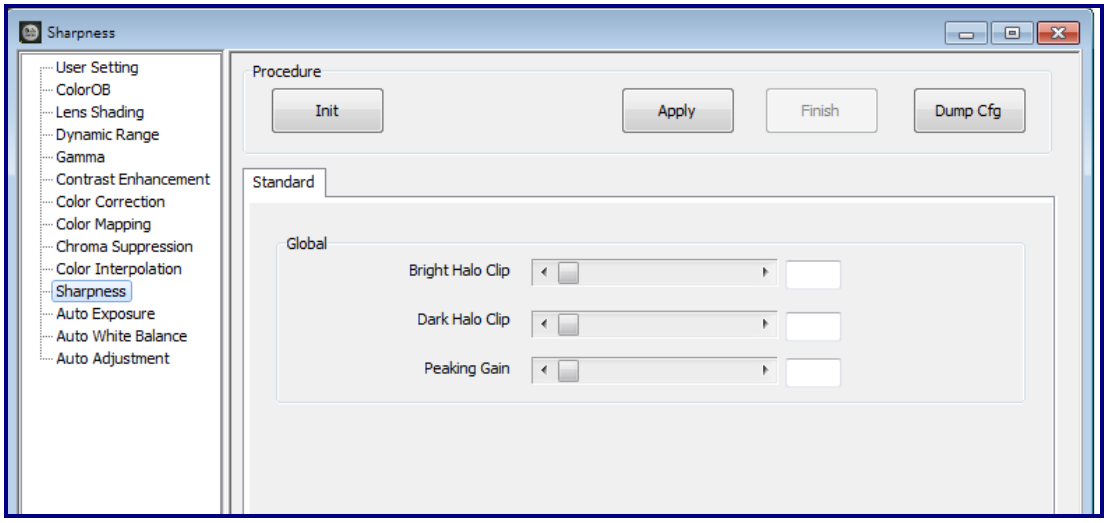
This page is used to calibrate and output the parameters of the Grain Media ISP Color Interpolation module. The procedures are explained as follows.



1. **Init**: This button is used to disable those modules, which will affect the calibration accuracy to confirm the correct results.
2. **Settings**: Adjust by setting EdgeDth, FreqTh, and FreqBlend.
3. **Finish**: Re-enable those modules which were disabled at the **Init** step.
4. **Dump Cfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on **Main Menu** to save the full configuration file.

3.2.11 Sharpness

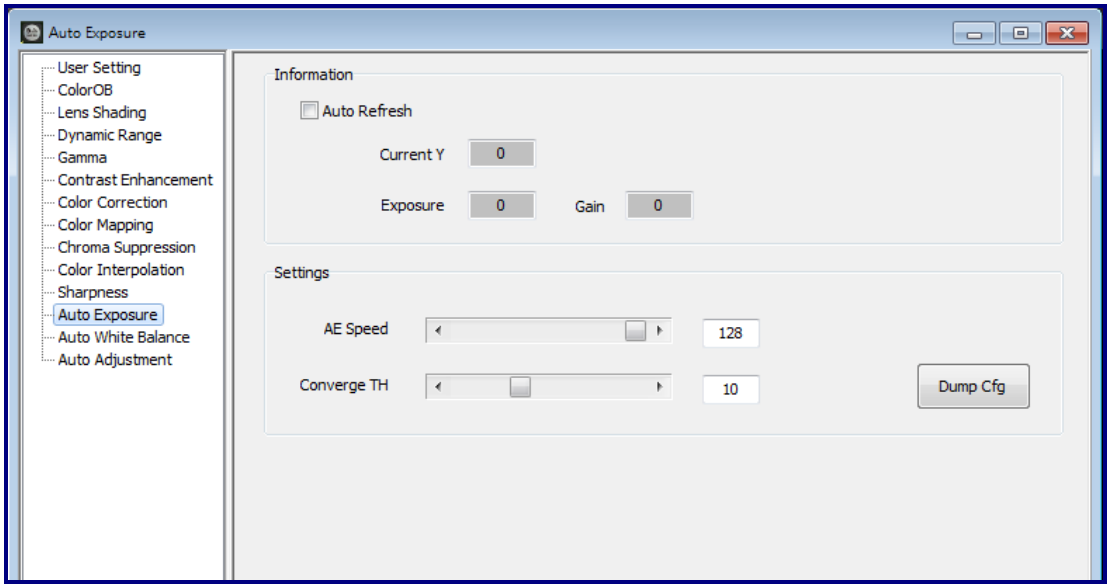
This page is used to calibrate and output the parameters of the Grain Media ISP Sharpeness module. The procedures are explained as follows.



5. **Init**: This button is used to disable those modules, which will affect the calibration accuracy to confirm the correct results.
6. **Settings**: Adjust by setting Bright Halo Clip, Dark Halo Clip, and Peaking Gain.
7. **Finish**: Re-enable those modules which were disabled at the **Init** step.
8. **Dump Cfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on **Main Menu** to save the full configuration file.

3.2.12 Auto Exposure

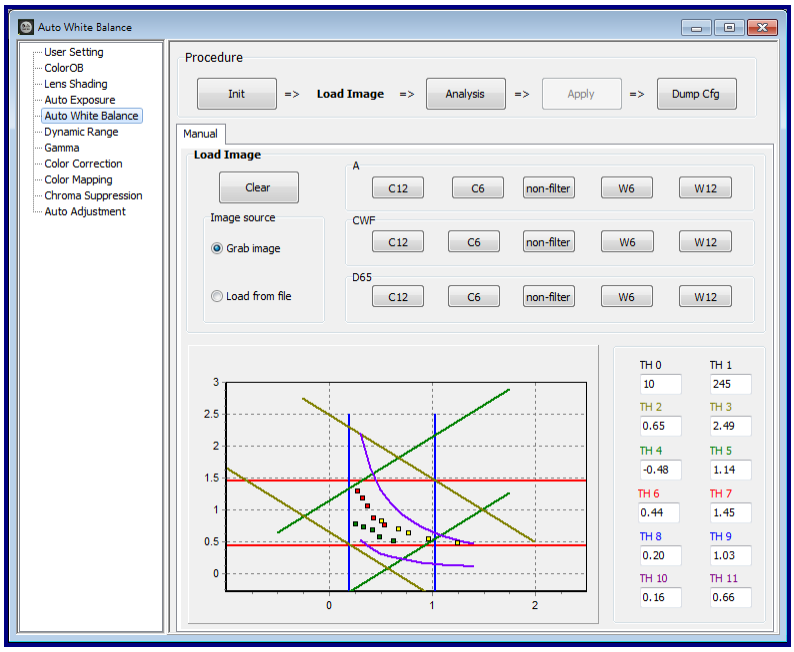
This page is used to set and output the parameters of the Grian Media ISP AE module. The procedures are explained as follows:



- **Auto Refresh**: Check the button to regularly return the AE metering value, exposure (**millisecond)**, and sensor gain
- **AE Speed**: Adjust the AE converge speed
- **Converge TH**: Adjust the AE converge threshold
- **Dump Cfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on **Main Menu** to save the full configuration file.

3.2.13 Auto White Balance

This page is used to calibrate and output the parameters of the Grian Media ISP AWB module. The procedures are explained as follows.



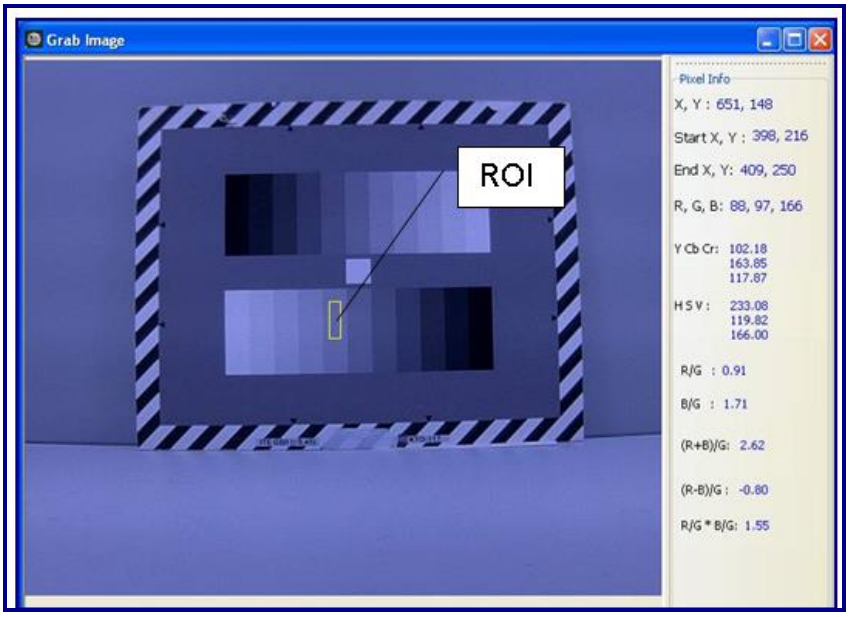
1. **Init**: This button is used to disable those modules, which will affect the calibration accuracy to confirm the correct results.

2. **Load Image/Grab Image**:

   - Use Chart: Gray scale chart (ITE, Kodak…)
   - Light Source: The buttons in light source group (A, CWF, D65) indicates the target color temperture and "**C**", "**W**" indicates that Cool or Warm color filters was used.

     Please sequentially click the buttons in different light source groups to grab/load the images according to the corresponding light source and mark ROI on the grabbed/loaded image. This tool will then measure the color information as the calibration database and show the results on the graphic.

     The caption color of the button will become red/green/blue after image has been grabbed/loaded.



3. **Analysis**: Start auto calibration and generate parameters
4. **Apply**: Apply the result parameters to ISP
5. **DumpCfg**: Dump the parameters of this module in the format of the configuration file. Also, users can use the "**Save Cfg**" button on **Main Menu** to save the full configuration file.
6. **Restore**: Re-enable those modules which were disabled at the **Init** step.

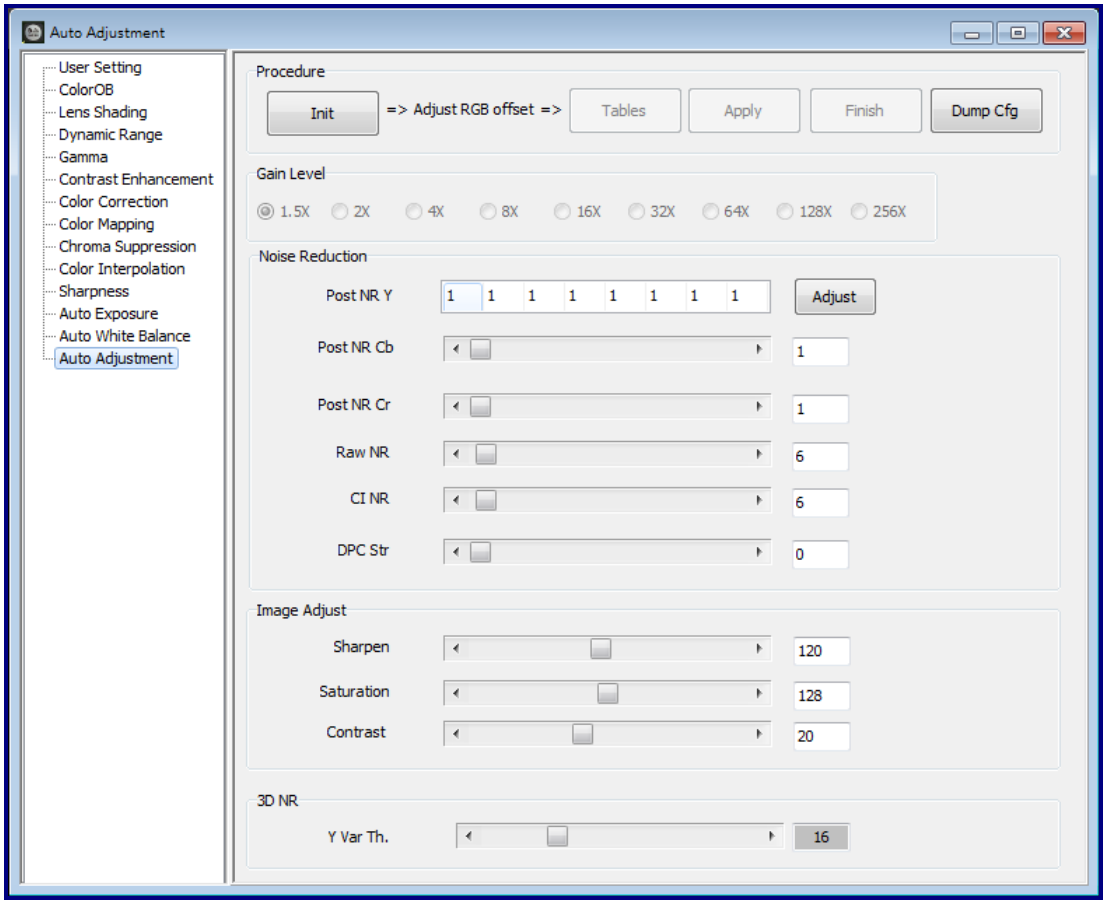
Notes:

1. **TH0** and **TH1** indicate the min. and max. Y thresholds for measuring white point.
2. Users can also manually revise the output parameters or drag and drop the TH2 ~ 11 of chart to adjust the level gate of the white point. There are two points should be awared before doing adjustment:
   - If the level gate was tight, accuracy of AWB will be better, but the AWB parameters should be re-calibrated when lens was changed.
   - If the level gate was loose, the parameters may be adaptable for different lens, but the AWB accuracy will reduce.

3.2.14 Auto Adjustment

Since change of sensor gain usually companies with noise level variance. In order to get best image quality, GM ISP firmware will auto adjust several parameters such as noise reduction, sharpness, saturation, etc. There are 9 pre-defined gain levels in Grain Media ISP driver. User can do adjustment by these 9 levels. When the current gain is within two levels, firmware will auto interpolated according to these levels.

This page is used to calibrate and output the parameters of the Grain Media ISP Denoise module. The procedures are explained as follows:



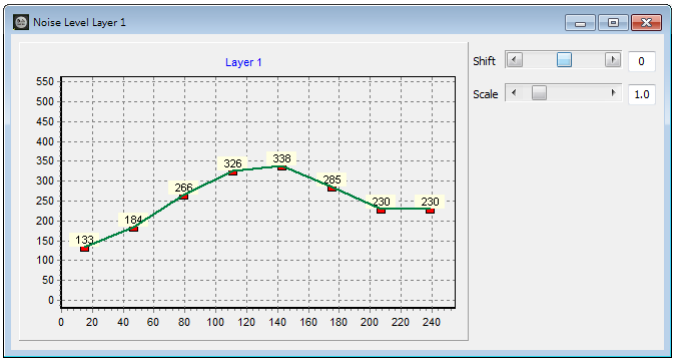
1. **Init**: This button will get the max gain of current sensor and auto divide the gain levels.
2. **Calibration Steps**: To get best image quality in different illuminance environment, user should do adjustment of all the gain levels.

   (1) Select Gain Level: Select the gain level will set the maximum gain into ISP driver.

(2) Adjust illuminance to fit current gain to current gain level. Current gain and current average Y are displayed on the right side.

(3) Adjust parameters related to this gain level. The parameters are explained as follows:

- Post NR: Post NR is a powerful noise reduction module in YUV domain. Users could execute ... for further Noise Level settings.



-
- Raw NR: This will adjust the strength of "Raw Domain Noise Reduction" module.
- CI NR: This will adjust the strength of noise reduction module which was combinded in color interpolation moduel.
- DPC: This will adjust the strength of the "Defect Pixel Cancellation" module.
- Sharpness: This will adjust the strength of "Sharpness" module.
- Saturation: This will will adjust the image saturation. Usually, for chroma noise reduction, user can reduce saturation under low light condition.
- 3D NR: This can adjust the strength of "Temporal Noise Reduction" by Luma. The larger value stands for stonger strength of 3DNR.

3. **Apply:** After each gain level is calibrated, users can click the "Apply" button to apply all gain level settings to the device, and click the "Finish" button to check the results.
4. **Finish:** Re-enable those modules which were disabled by **Init** step.
5. **Dump Cfg:** Dump the parameters of this module in the format of the configuration file.