

Defective Pixel List Management Tool for Prosilica GT models with PYTHON sensors

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Introduction

This document presents instructions on how to mask and manage pixel defects using the **Defective Pixel List Management Tool**. The **Defective Pixel List Management Tool** allows you to manage both camera defined (factory defined) pixel defect list and a user defined pixel defect list to match your application and optimize the life-cycle of the camera. You can also revert the camera to the factory defined pixel defect list. There are two memory locations for the defect pixel lists. The factory defect pixel list is set during calibration (production) and cannot be modified by the user. The user defined defect pixel list is defined by the user. The two lists are then merged.

Defect pixels are inherent to all CMOS and CCD sensors, due to silicon impurities and manufacturing effects. Impurities in silicon wafers and sensor production processes make it very difficult to obtain defect-free CCD or CMOS sensors. Sensor manufacturers have different grades of sensors based on the number of pixel defects. Those with few to none are classified as higher-grade and are much more expensive. Some specific applications, such as flat panel inspection, might require these higher-grade sensors. Most machine vision applications, however, do not require a “perfect” sensor and the standard grade sensors are a much more cost-effective solution. The **Defective Pixel List Management Tool** allows you to mask these pixels along with defect pixels which may be visible due to your specific application configuration.

Prerequisites

The following items are required:

- Allied Vision GigE camera with `DefectMaskEnable` feature
Supported model series:
 - Prosilica GT4090, GT4096, GT5120



You can enable or disable defect masking in **Vimba Viewer**, under `Controls > DefectMaskEnable = true/false`. By default `DefectMaskEnable` is `true`.



For Prosilica GT1660, GT1910, GT1920, GT2300, GT2750, GT3300, GT3400, GT4905, GT4907, GT6600 model series, refer to the Load Defect Tables Tool Application Note.

https://www.alliedvision.com/fileadmin/content/documents/products/cameras/various/appnote/GigE/Load_Defect_Tables_Tool.pdf



For Mako G-030, G-131, G-192, G-223, G-419, G-503, Manta G-223, Manta G-419, Prosilica GT2000, and GT2050 model series, refer to the Defect Mask Loader Tool Application Note.

https://www.alliedvision.com/fileadmin/content/documents/products/cameras/various/appnote/GigE/Defect_Mask_Loader_Tool.pdf

- **Vimba Viewer** installed on the host PC to adjust the camera settings and get an image. **Vimba Viewer** is part of the Vimba SDK API which can be downloaded from our website.



To download **Vimba Viewer**, go to:

<https://www.alliedvision.com/en/products/software.html>

- **Defective Pixel List Management Tool** to view, create, and manage defect pixel lists.



To download the **Defective Pixel Lists Management Tool**, go to:

<https://www.alliedvision.com/en/support/software-downloads>



This tool is for use with Microsoft Windows® only.

- Third-party image processing program such as **ImageJ** to inspect the image and identify pixel defects in an image.



To download **ImageJ** go to:

<http://rsbweb.nih.gov/ij/download.html>

Defining defects

A pixel defect has a response that deviates more than a specified value (threshold, deviation) from the local background in a dark image, corrected gray image, or a saturated image. As application requirements differ, it is not possible to find a common denominator to exactly define when a pixel is defective and when it is not. As consequence, sensor manufacturers define defects in various ways.

Almost all image sensors have a certain proportion of pixels that are defective and are commonly referred to as “bad” pixels or pixel defects. These pixels manifest due to defects in design of the semiconductor chip or manufacturing errors. They can also develop during operation of the sensors, particularly when the operating conditions are harsh and the sensors are operated for long periods of time.

Pixel defects can usually be divided into four main groups:

- Stuck high pixels are those which produce output values much higher than expected from its surrounding neighbors, even until the point of saturation of the value. Signal value is saturated or close to saturation and not influenced by light.

- Stuck low pixels are pixels whose values are much lower than expected from neighboring pixels and the value may even be completely low. Signal value is 0 or close to zero and not influenced by light.
- Hot pixels are pixels whose signal value is much higher than the neighbors and getting higher with exposure and temperature.
- Dark pixels are pixels whose signal value is much lower than the neighbors but not necessarily stuck low.

Dark current, that is a major contributor to pixel defects, is highly sensitive to temperature. Therefore, pixel defects and associated detection threshold levels are usually defined for a specific operating temperature.

For more information, please refer to the sensor data sheet or contact the sensor manufacturer. For sensor warranty information, see our [Sensor Warranty Terms](#).

Detecting pixel defects



We advise using a homogeneous image to detect pixel defects. It may be harder to detect pixel defects in a usual scene versus a homogeneous bright or dark scene.

1. Connect your Allied Vision GigE camera to the host computer and power, and start **Vimba Viewer**. Wait until the camera is listed in the **Detected Cameras** list. This may take a few seconds.
2. Click on the camera serial number and open the **Features** window by selecting the **All** tab.
3. In **Controls** > **DefectMask**, set **DefectPixelEnable** to *disable*.
4. In **Controls** > **Exposure**, increase **ExposureTimeAbs** to a value suitable for your application or until pixel defects are visible.

Increasing exposure time will increase the number of hot pixels; however, these may not be considered as pixel defects by the sensor manufacturer. Check the sensor data sheet to see if there is constraint on exposure value in defect pixel definition.

5. In **Controls** > **GainControl**, increase **Gain** to a value suitable for your application. We recommend setting **Gain** to 0 as **Gain** can cause pixels to appear noisy.

For bright image acquisition, use an EMVA1288 compliant optical setup providing uniform illumination of the sensor with white light (CCT = 5000 to 6500 Kelvin). For bright image acquisition, the video signal level should be in the 60 to 70 percent range (or full scale).

For dark image acquisition you can leave the lens cap attached.

6. Click the **Freerun** button to initiate live camera view. Right-click on the image and uncheck **Color Interpolation**. Right-click on the image and save the image to the host computer as a TIFF file.

Let the camera run for 30 minutes to allow the camera temperature to normalize before saving an image. Ambient temperature should be in the 20 to 25 degrees Celsius range.

We recommend saving both a dark image and a bright image. A dark image will allow you to detect hot pixels. A bright image will allow you to detect dead pixels.



RAW and monochrome pixel formats are better for defect pixel detection.

- Open the saved TIFF files in **ImageJ** or a similar application. Locate the exact coordinates of pixel defects using the application tools.



You can also select the defect pixels by using **Threshold** functionality in **Image/Adjust** menu in **ImageJ**.

Defect Pixel List Management tool

Camera Connection tab

The **Camera Connection** tab allows you to manage the connections to the Allied Vision cameras. The detected cameras available to the system will be listed here. This list is automatically refreshed when new cameras are discovered, however, the **Refresh** button may be used to force a refresh.

Connect to a camera

- With **Vimba Viewer** closed, run DefectivePixelListManager.exe.
- Connect a supported camera to the host computer.

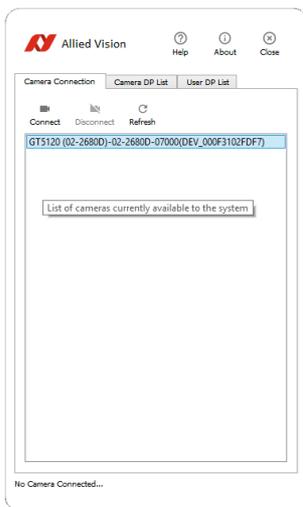


Figure 1: Detected cameras

- Select a camera from the list and click the **Connect** button to connect to the selected camera.

Disconnect

Click the **Disconnect** button to disconnect the currently connected camera.

Refresh

Click the **Refresh** button to force a refresh of detected cameras.

Camera DP List tab

In the **Camera DP List** tab you can download the list of pixel defects that are currently stored in the connected camera, restore a previously saved list of pixel defects to the connected camera, backup the current camera pixel defect list to a file, and revert back to the factory pixel defect list settings.

Download

Click the **Download** button to view the list of pixel defect coordinates from the connected camera. The row and column coordinates are displayed for each pixel defect.

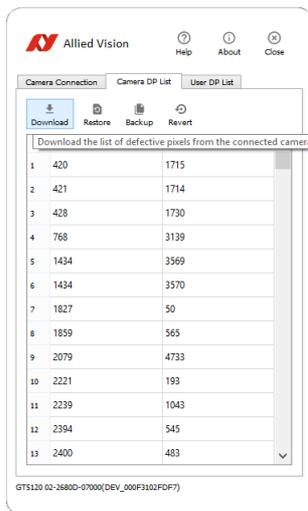


Figure 2: Download the pixel defect list

Restore

Click the **Restore** button to restore a previously saved backup pixel defect list from the host PC to the connected camera. The backup file is a *.bin format binary file and is camera model specific. **Restore** allows you to switch between different pixel defect configurations for various lighting and operating conditions.



The **Defective Pixel List Management Tool** verifies the file format, corrupt file check, and that the sensor size matches the connected camera. The tool does not check the camera serial number or model number.

Backup

Click the **Backup** button to save the current pixel defect list to the host PC. The backup file is saved as a *.bin format binary file and is camera model specific. The serial number is added to the backup file name when saved.



*.bin format binary files cannot be manually altered on the host PC.

Revert

Click the **Revert** button to revert back to the original factory pixel defect list settings. All user defined pixel defects will be removed. A warning message will be displayed requesting confirmation to continue.

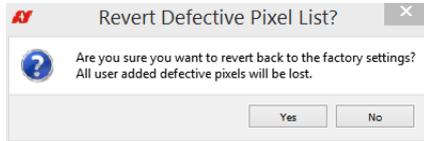


Figure 3: Revert Defective Pixel List confirmation message

User DP List tab

In the **User DP List** tab you can load a user defined pixel defect list, save the current defect pixel list, add a pixel defect, clear all pixel defects in the list, remove a pixel defect, and upload the user defect pixel list to camera storage. The pixel defect correction algorithm is optimized to correct four or less consecutive pixels in a row. The maximum number of pixel defects that can be corrected is eight in a row. If more than the recommended four pixel defects are detected, they will be highlighted in yellow. Rows highlighted in red represent pixel defect coordinates that are outside of the correctable limits or sensor size.

Load

Click the **Load** button to load a user pixel defect list from a file on the host PC. The file must be a *.csv comma-separated values file with the header "Row, Column". Coordinate values must be unsigned integer values in the range of [0,65535]. Any value outside this range or any other character/symbol will be coerced to zero. This file is not camera or model specific.



You can load a user pixel defect list with multiple pixel defect coordinates. For best results limit the number of consecutive pixel defects to four or less.

Save

Click the **Save** button to save the current user pixel defect list to a file on the host PC. The list is saved in a *.csv comma-separated values file. This file is not camera or model specific.

Add

Click the **Add** button to add a pixel defect coordinate to the user pixel defect list.

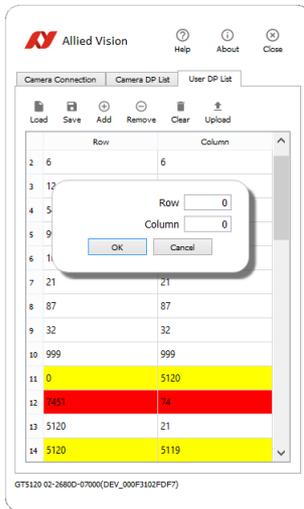


Figure 4: Add a single pixel defect

Enter the row and column coordinates of the pixel defect and click **OK** to add the pixel defect to the list. Click **Upload** to complete the action by uploading the modified pixel defect list to the connected camera.

Remove

Select a defect pixel in the list and click the **Remove** button to remove that pixel defect from the user pixel defect pixel list. Click **Upload** to complete the action by uploading the modified pixel defect list to the connected camera.

Clear

Click **Clear** to clear the current user pixel defect list.

Upload

Click the **Upload** button to upload the user pixel defect list to camera storage. The user pixel defect list is combined with the camera pixel defect list. An error message is displayed if an uncorrectable or unrecommended pixel defects have been entered and highlight the rows that do not meet the criteria. Select the highlighted row and click the **Remove** button to remove the entry before proceeding with an upload.



Duplicate pixel defects will be ignored. Only one instance of the pixel defect will be uploaded to the camera.



Once you upload user defined pixel defect coordinates to the camera you cannot remove any pixel defects. You would need to revert the camera to camera back to the original factory configuration or load a previous camera pixel defect list backup.

Error messages and conditions

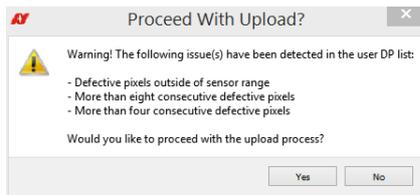


Figure 5: Error message example

Pixel defect coordinates are highlighted in yellow

When five to eight consecutive pixel defect coordinates are added they are highlighted in yellow to indicate that this is not recommended. After selecting the **Upload** button, you will be prompted with a confirmation windows before these coordinates are uploaded to the camera.

Pixel defect coordinates are highlighted in red

Pixel defect coordinates that are highlighted in red cannot be corrected. After selecting the **Upload** button, these coordinates will be ignored and will not be uploaded to the connected camera. When entering more than four pixel defect coordinates the pixel to the left will be omitted.

The algorithm used to correct the pixel defect always uses the value to the left of the pixel defect. If there is no active pixel to the left of the pixel defect, then the pixel defect cannot be masked.

Confirm pixel defects are masked

1. Connect your Allied Vision GigE camera to the host computer and start **Vimba Viewer**. Wait until the camera is listed in the **Detected Cameras** list. This may take a few seconds.
2. Click on the camera serial number and open the **Features** window by selecting the **All** tab.
3. In `Controls > DefectMaskEnable`, set the feature to `true`.
4. Click the **Freerun** button to initiate live camera view. Right-click on the image and uncheck **Color Interpolation**. Right-click on the image and save the image to the host computer as a TIFF file.
5. Open the saved TIFF file in **ImageJ** or a similar application. Confirm that the pixel defects entered into the tool have been masked.

For technical support, please contact support@alliedvision.com.

For comments or suggestions regarding this document, please contact info@alliedvision.com.

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