APPLICATION NOTE

AN-P07

CHEETAH CAMERA SERIES

DEFECTIVE CLUSTER CORRECTION

Abstract: This application note describes how to create a defective cluster correction map and upload it into the Cheetah GMAX CoaXPress camera.

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Introduction

This application note provides procedures on finding defective pixels, strategies for correcting defective pixels and creating / uploading a DCC (Defective Cluster Correction) map.

A defective cluster is a group of N defective pixels that are considered as one unit for pixel correction purposes. For color sensors, the correction rules described below are applied within each color plane. The number and size of Cluster defects allowed for a GMAX sensor differ depending on the sensor type and grade.

Sensor	Max. # of pixels in a cluster	Max. # of clusters
Monochrome sensor Grade 2	4	12
Monochrome sensor Grade 3	9	20
Color Sensor Grade 2 with same color plane	4	12
Color Sensor Grade 2 with different color plane combined	13 (in any 5x5 pixel array)	12

Below are strategies for correcting each pixel in a cluster. Different strategies are used based on the location of the pixel within the cluster defect. To identify the various strategies, each pixel in the example cluster defects below is marked with a specific color. The color represents the type of correction strategy used for a particular pixel in a cluster. Three colors are used: Purple, Orange and Cyan.

TIP ⓘ

We recommend including orange pixels (see diagrams below) into DPM (Defective Pixel Map). Those pixels can be treated as single defects.

Mark coordinates of cyan pixels (see diagrams below) with the"-ad" flag (refer to the STEP 4 of the Locating and adding pixel coordinates section). The camera replaces these pixels with the adjacent pixels from the row above the defect pixel.

Three types of corrections are used.

Type 1 (Purple color) averages pixels in the same column as the defective pixel to determine the replacement value.. Pixels in the row just above and just below the defective pixel determine the correction value. (See below.)

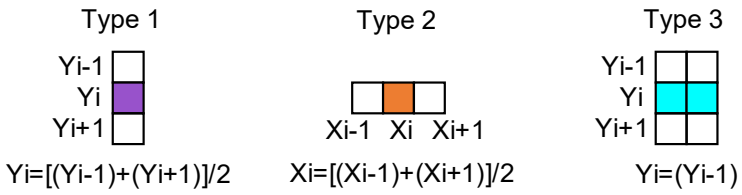
Type 2 (Orange color) averages pixels in the same row as the defective pixel to determine the replacement value. Pixels in the columns adjacent to the defective pixel determine the correction value.

NOTE ⊛

Single pixel defects identified in the HPM or DPM are corrected using Type 2 (Orange) correction. Any pixels in a cluster defect which are corrected using Type 2 method are not included in the DCC file, but instead are added to the .hpm (or .dpm) files.

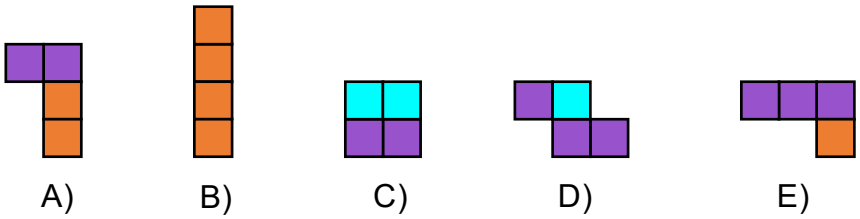
Type 3 (Cyan color) substitutes the defective pixel with the pixel value in the same column from the row above the defective pixel.

Below, the three types of corrections (Type 1, Type 2 and Type 3) are shown schematically.
Averaging and substitution are used to mask defect pixels:

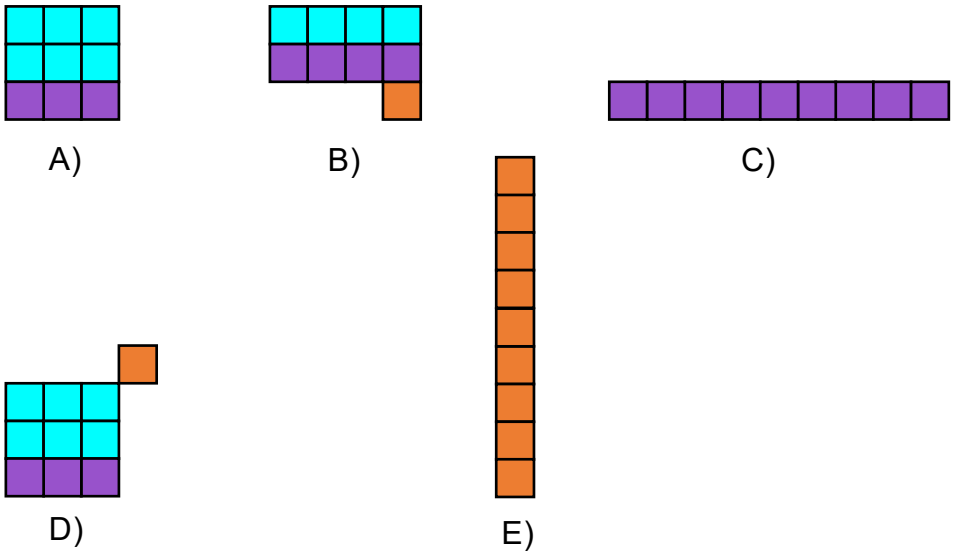


Clusters for Monochrome Cameras

The strategy for correcting cluster defects uses a combination of Type 1 (Purple), Type 2 (Orange) and Type 3 (Cyan) corrections. The shape of the cluster and the location of the pixel defects determines the type of correction used.
For example, clusters defects in Grade 2 monochrome sensors use the following combinations of corrections:

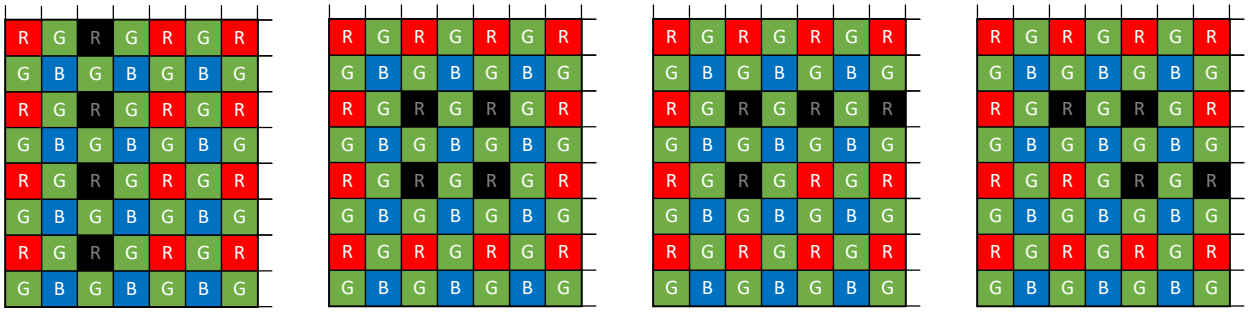


Clusters and pixel averaging for monochrome sensors Grade 3:

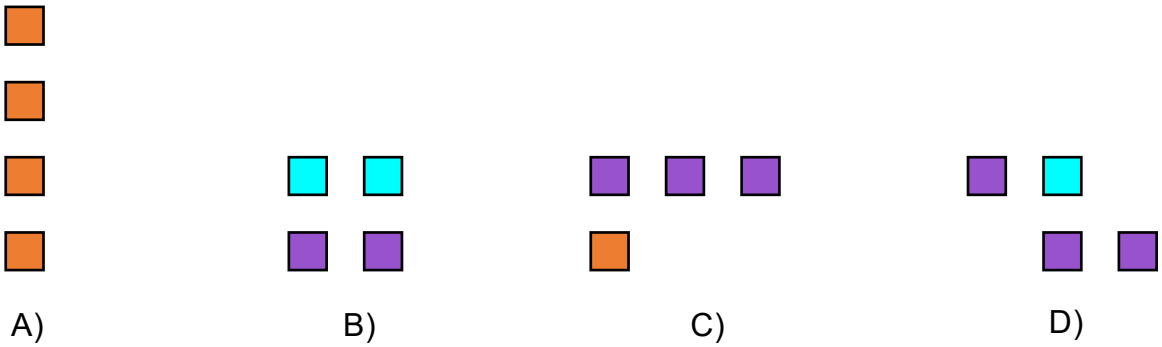


Clusters for Color Cameras

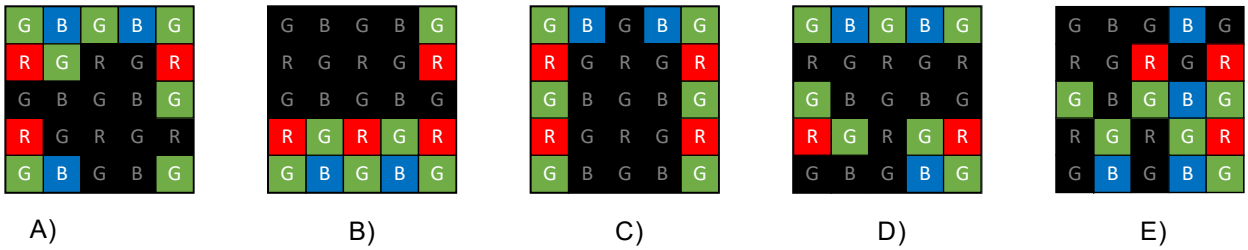
Clusters allowed within the same Bayer color plane for GMAX color sensors:



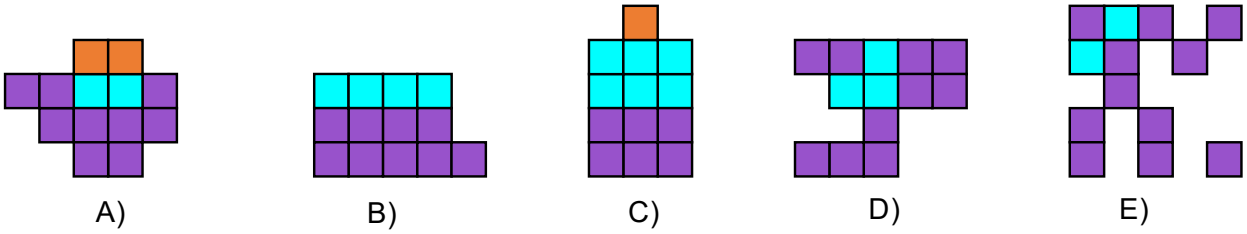
Pixel correction for clusters within the same Bayer color plane:



Clusters allowed within different Bayer color planes combined for GMAX color sensors:



Pixel correction for clusters with different Bayer color plane combined:



Finding Defective Pixels

To see the defective pixels that are not in the factory DCC and DPC map:

1. Make sure that the *DefectPixelCorrection* and *DefectClusterCorrection* are set to Factory in the Data Correction menu of the software GUI.
   The camera corrects the known pixel defects automatically.

2. Make sure that *TriggerMode* and *ExposureMode* are set to Off, OffsetX and OffsetY are set to 0, and the camera resolution is set to maximum.

3. Capture an image with a uniform light source illuminating the sensor at about 50% ADU capacity (~2000 for 12-bit, ~500 for 10-bit, ~130 for 8-bit modes).

4. Identify any visible defective pixel and add them to the DCC or DPM as described in Locating and adding pixel coordinates.

To see the defective pixels included in the factory DCC map:

1. Set *DefectClusterCorrection* to Off in the Data Correction menu.

2. Make sure that *BadPixelCorrection* and *DefectPixelCorrection* are set to Factory.

3. Repeat steps 2–4 of the previous procedure.

TIP ⓘ To obtain the factory DCC map, contact Imperx technical support at:
Email: support@imperx.com
Toll Free: 1 (866) 849-1662 or (+1) 561-989-0006
Fax: (+1) 561-989-0045
Visit our website: www.imperx.com.

To upload a new DCC map into the camera, see Uploading DCC Map.

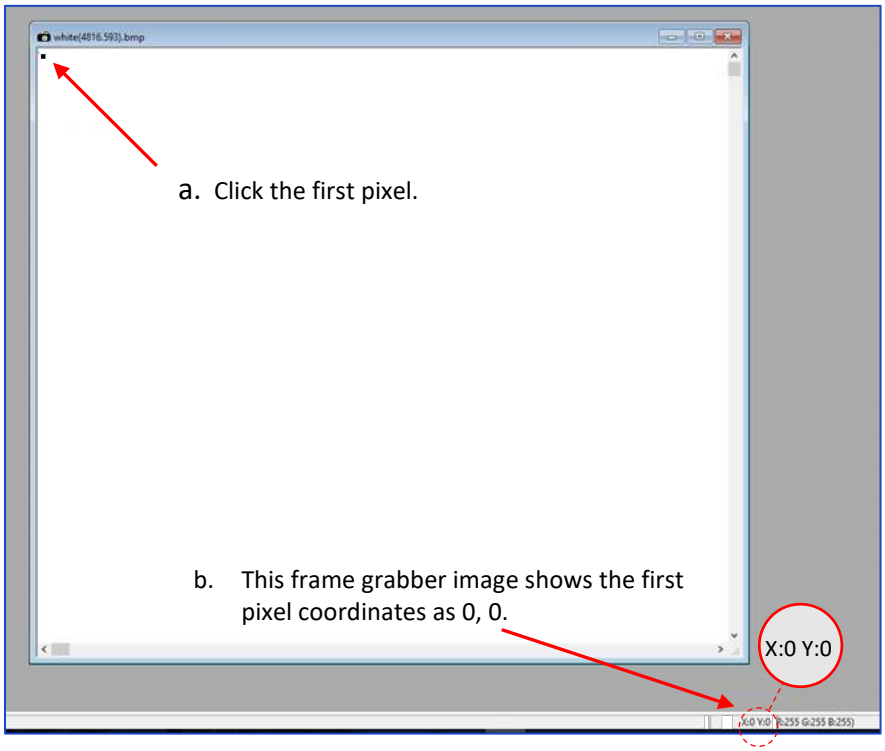
Locating and adding pixel coordinates

Follow the steps below to find first pixel coordinates, locate and adjust defective pixel coordinates, and accurately place defective pixel coordinates into the pixel map.

STEP 1: Find the First Pixel Coordinates

Your frame grabber's first pixel coordinates can affect the location accuracy of defective pixel coordinates. So, you must find the image sensor's first pixel coordinates and potentially adjust the defective pixel coordinates based on your findings.

Click the first pixel at the upper most left corner of the screen to find your frame grabber's first pixel X, Y coordinates.

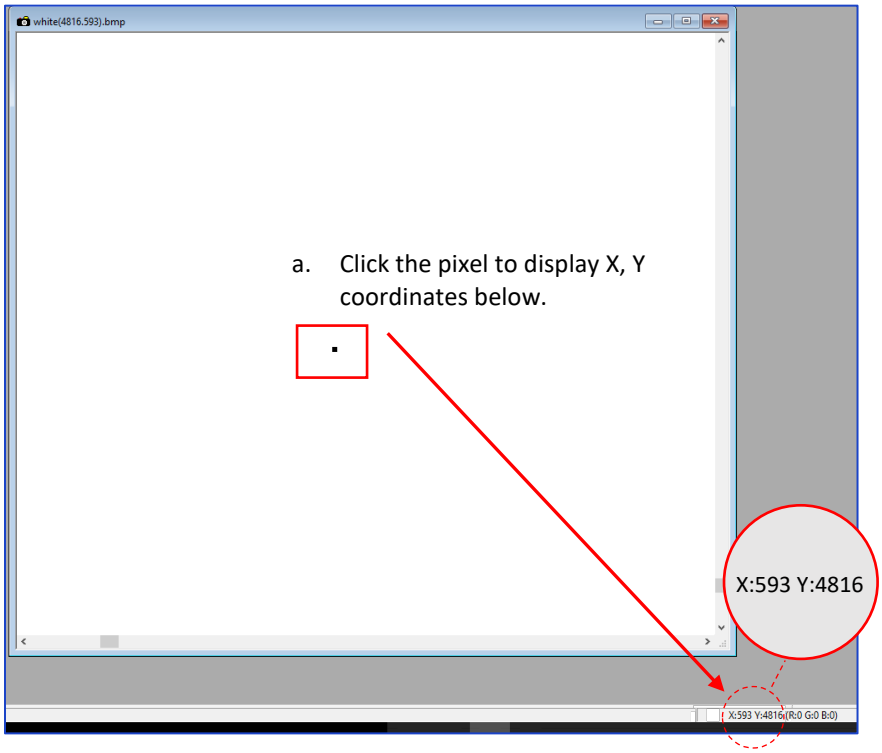


The coordinates will be either 0, 0 or 1, 1:

- If your frame grabber's first pixel coordinates are 0, 0, you should add 1 to both the X and Y coordinates of the defective pixel.
- If the first pixel coordinates are 1, 1, do not add 1 to either coordinate.

STEP 2: Find Defective Pixel Coordinates

Click the defective pixel to find its X, Y coordinates.



The coordinates are 593, 4816, where X (Column) = 593 and Y (Row) = 4816.

IMPORTANT: Frame grabbers from different manufacturers may display pixel location coordinates in different order, for example:

X (Column), Y (Row) or,
X (Row), Y (Column).

You must put defective pixel coordinates into the pixel correction map file in this order:
X (Column), Y (Row).

If your frame grabber identifies pixel coordinates by X **(Row)**, Y **(Column)**, you must transpose the coordinates to X (**Column**), Y (**Row**) before entering them into the pixel map files. For example, if the 593, 4816 coordinates in the screen above had been displayed in this order, where X:593 is a row and Y:4816 is a column, you would have had to transpose the coordinates to 4816, 593.

STEP 3: Adjust Defective Pixel Coordinates

As described in **STEP 1**, if the first pixel coordinates are 0, 0, you must adjust the defective pixel coordinates by adding 1 to both coordinates as shown in the following:

593 (+1), 4816 (+1) = 594, 4817

- If the frame grabber pixel coordinates are Column (X), Row (Y), then go to **STEP 4**.
- If the frame grabber pixel coordinates are Row (X), Column (Y), then transpose the coordinates to the form Column, Row and then go to **STEP 4**.

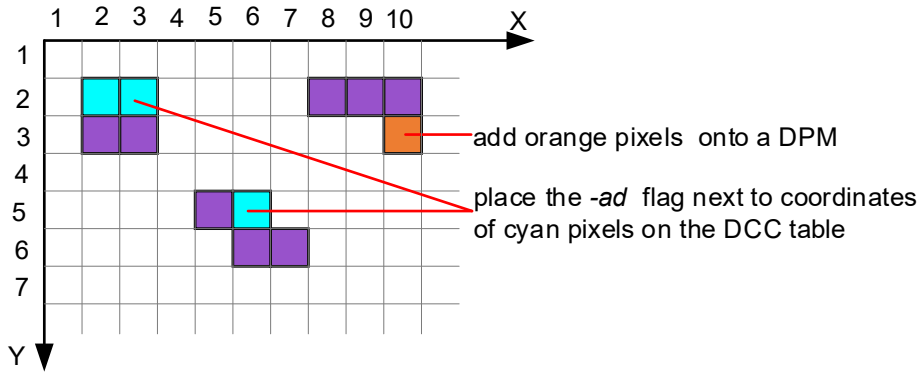
STEP 4: Add Defective Pixel Coordinates to Defective Cluster Correction Map

The DCC file is a text file with .dcc. extension. The maximum number of pixels in DCC map is 1024.

Place the defective pixel coordinates in the Defective Cluster Correction file in ascending (increasing) numerical order of the Y (row) coordinate. The value of all Y coordinates should progressively increase as you look down the list of X, Y coordinates.

NOTE ⊛ If adding a defective pixel with a Y location identical to one or more other defective pixels, insert its coordinates in the order of increasing X location.

The example below shows how to build a defective cluster correction table for a monochrome Grade 2 sensor. Only the purple (Type 1 correction) and cyan colored pixels (Type 3 correction) are entered into the .dcc file as shown below. The pixels corrected with Type 2 correction (Orange pixel) are not included in the DCC file and should be added to either the .dpm or .hpm file. Type 3 correction (Cyan colored pixels) are designated with the '-ad' flag in the DCC file. (see below)




```
-- Defective Cluster Correction,
-- Date: 6.08.2020,
-- Model#: CXP-C9440M-RF,
-- Serial#: LAC001,
:Table,
-- Column(X),Row(Y)
            2,2-ad
            3,2-ad
            8,2
            9,2
            10,2
            2,3
            3,3
            5,5
            6,5-ad
            6,6
            7,6
```

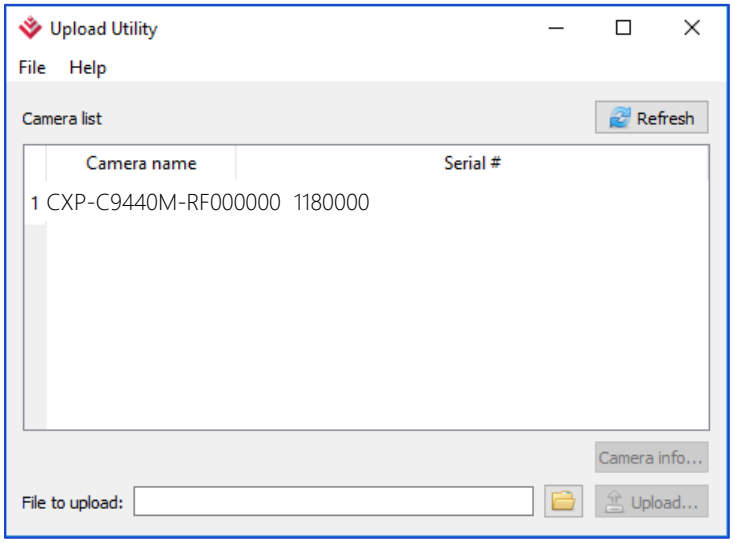
STEP 5: Save your DCC file

Save your Defective Cluster Map with the file extension .dcc.

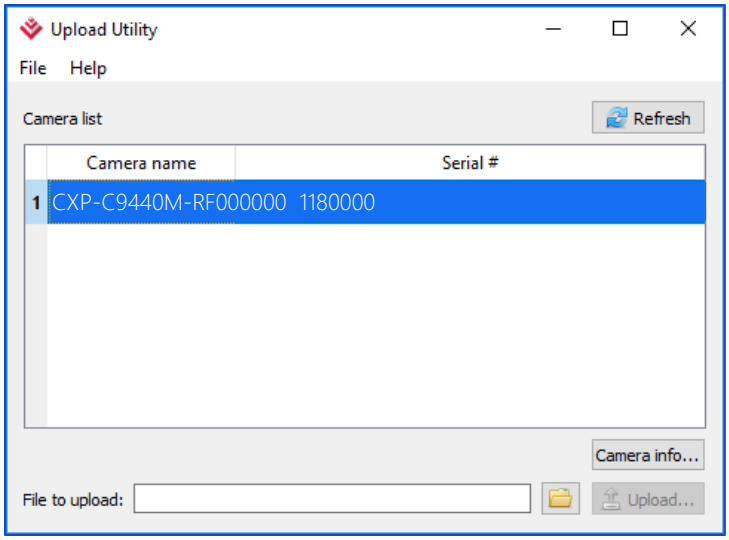
Uploading DCC Map

1. Connect and power up your camera.

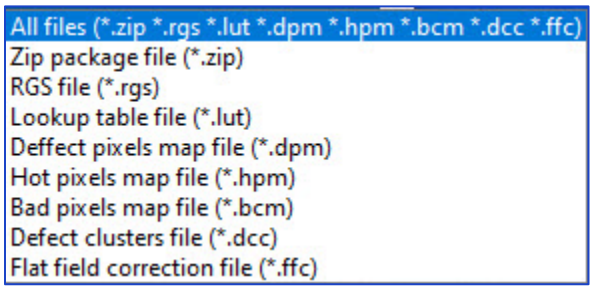
2. Start the Imperx **Upload Utility** and wait for the Utility to detect the camera.
   If the utility does not detect the camera, click **Refresh** to restart the device collection.



3. Select the camera to update if more than one appears.



4. Browse for the edited .dcc file, select it, and click **Upload**.
   Wait for the upload to finish.



5. After the upload is completed, do a power cycle on the camera.

6. After the camera re-starts, start your software GUI and select **Data Correction**.

7. Make sure that *DefectiveClusterlCorrection* is set to **User** so that the camera uses the map you loaded.

8. Retake images as described in sections Finding Defective Pixels to make sure that all defective and hot pixels are now corrected.