



ULTRACAM

Calibration Report



Camera: UltraCam Eagle
Serial: UC-E-1-00817310-f80

Laboratory Calibration Date: Mar-14-2022
Camera Revision: Rev10.00

Date of Report: Mar-16-2022
Version of Report: V01

Copyright © 2022 by Vexcel Imaging GmbH, Graz - Austria.

The contents of this document may not be reproduced in any form or communicated to any third party without the prior written consent of Vexcel Imaging GmbH.

While every effort is made to ensure its correctness, Vexcel Imaging GmbH assumes no responsibility neither for errors and omissions which may occur in this document nor for damage caused by them.

Vexcel Imaging GmbH does not make a commitment to update the information and software discussed in this document.

All mentioned trademarks or registered trademarks are owned by their respective owners.

Printed in Austria at Vexcel Imaging GmbH. All rights reserved.

Venice, Italy

Photo on page 1 courtesy of Vexcel Imaging GmbH



ULTRACAM

Geometric Calibration

Camera: UltraCam Eagle
Serial: UC-E-1-00817310-f80

Panchromatic Camera: ck = 79.800 mm
Multispectral Camera: ck = 79.800 mm

PPA Information: X: 0.000mm
Y: 0.000mm



Panchromatic Camera

Large Format Panchromatic Output Image

| | | | |
|--------------------------------------|----------------------------------------|-----------------------|--------------------------|
| Image Format | long track cross track | 68.016mm 104.052mm | 13080pixel 20010pixel |
| Image Extent | | (-34.008, -52.026)mm | (34.008, 52.026)mm |
| Pixel Size | | 5.200μm*5.200μm | |
| Focal Length | ck | 79.800mm | ± 0.002mm |
| Principal Point (Level 2) | X_ppa | 0.000mm | ± 0.002mm |
| | Y_ppa | 0.000mm | ± 0.002mm |
| Lens Distortion | Remaining Distortion less than 0.002mm | | |

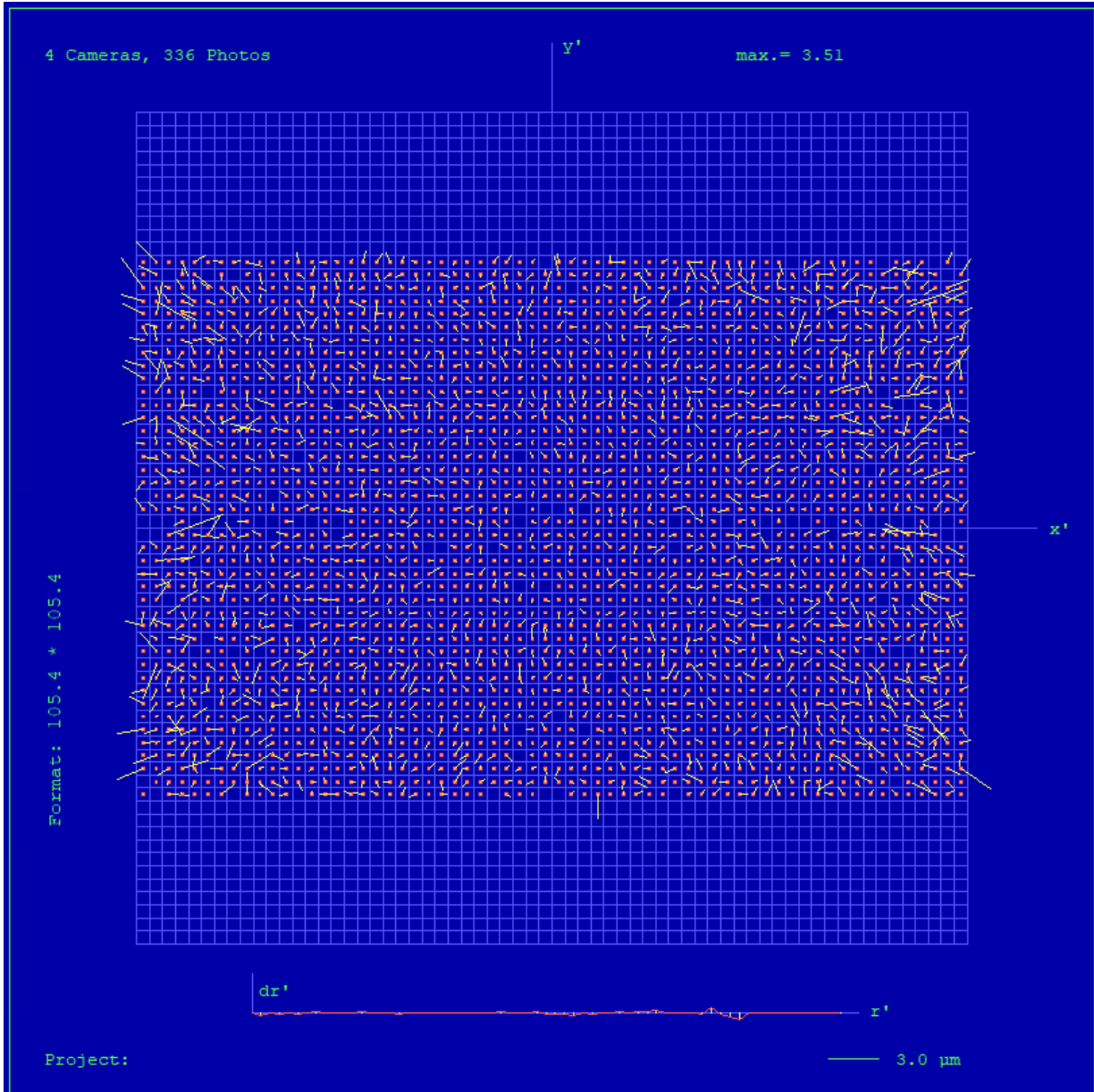
Multispectral Camera

Medium Format Multispectral Output Image (Upscaled to panchromatic image format)

| | | | |
|--------------------------------------|----------------------------------------|-----------------------|------------------------|
| Image Format | long track cross track | 68.016mm 104.052mm | 4360pixel 6670pixel |
| Image Extent | | (-34.008, -52.026)mm | (34.008, 52.026)mm |
| Pixel Size | | 15.600μm*15.600μm | |
| Focal Length | ck | 79.800mm | ± 0.002mm |
| Principal Point (Level 2) | X_ppa | 0.000mm | ± 0.002mm |
| | Y_ppa | 0.000mm | ± 0.002mm |
| Lens Distortion | Remaining Distortion less than 0.002mm | | |



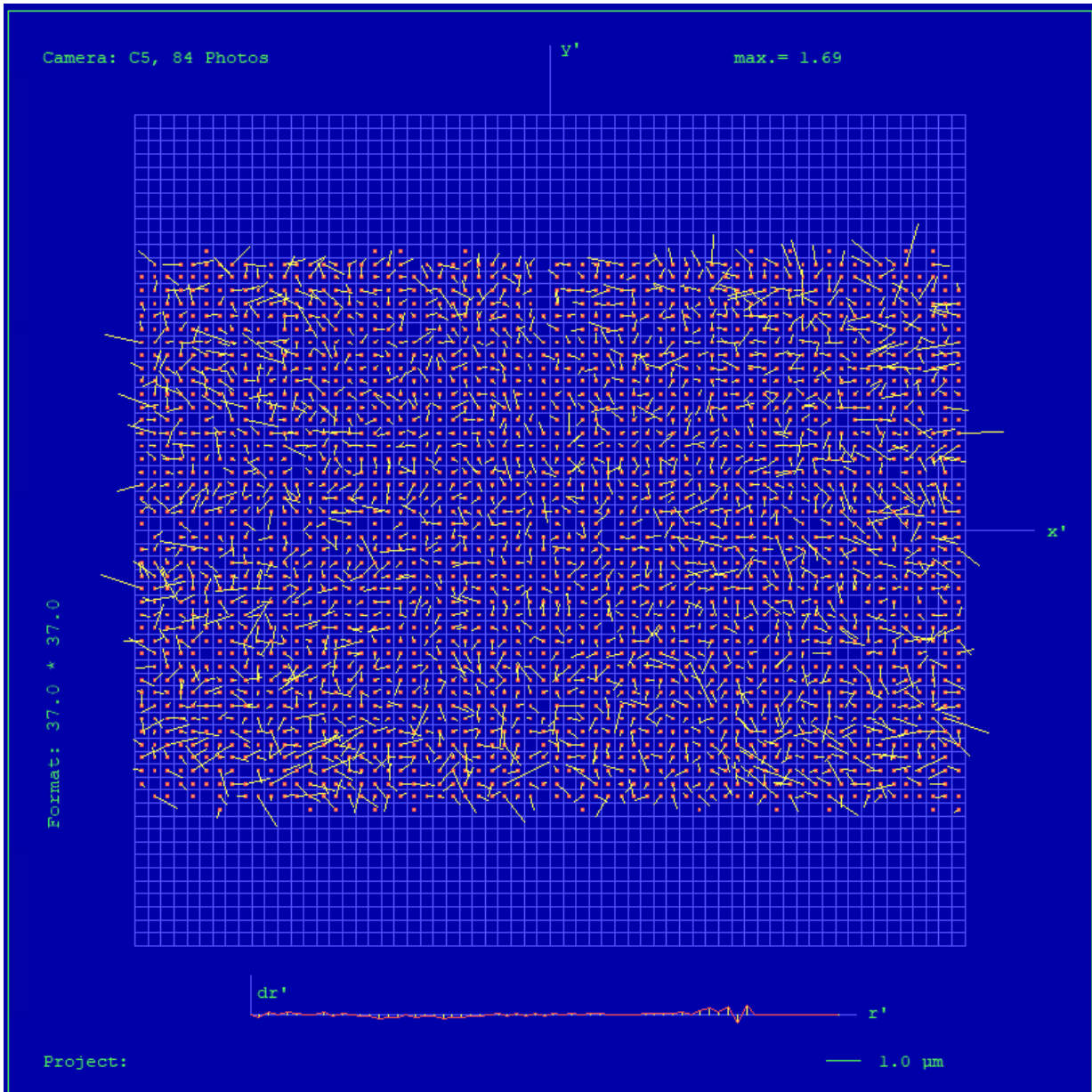
Full Panchromatic Image, Residual Error Diagram



Residual Error (RMS): 0.79 μm



Green Cone (Cone 5), Residual Error Diagram



Residual Error (RMS): 0.63 μm



Explanations

Calibration Method:

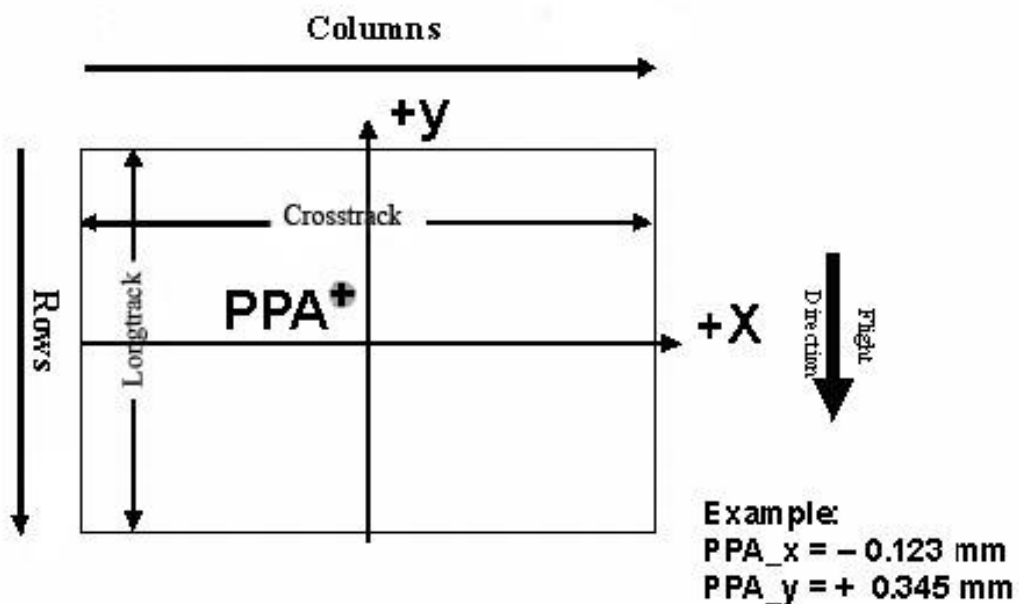
The geometric calibration is based on a set of 84 images of a defined geometry target with 394 GCPs.

Number of point measurements for the panchromatic camera : >16000
Number of point measurements for the multispectral camera : >60000

Determination of the image parameters by Least Squares Adjustment.
Software used for the adjustment: BINGO (GIP Eng. Aalen, Germany)

Level 2 Image Coordinate System:

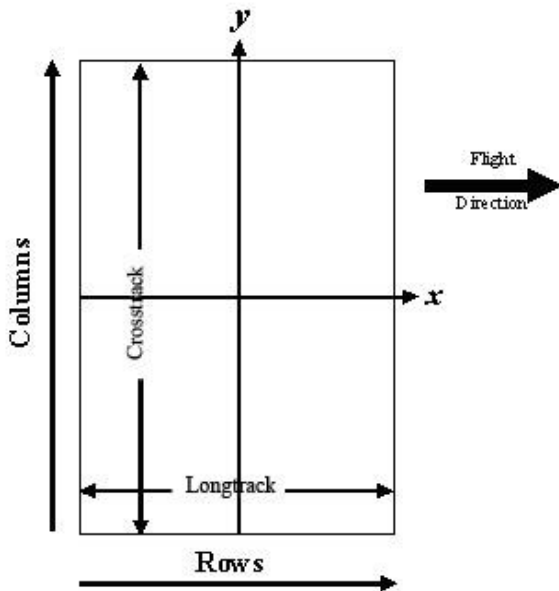
Lvl2, Camera prop. Orientation



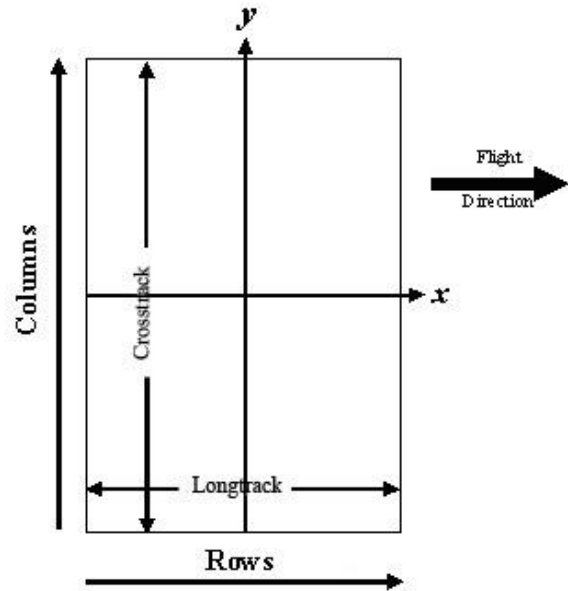
The image coordinate system of the Level 2 images is shown in the above figure. The basic image format and coordinate of the principal point in the level 2 image is given on page 4 of this report. The above figure shows the position of an example principal point at the coordinate (-0.123 / 0.345).



Level 3 Image Coordinate System:
(after rotation of 270° CW)



Panchromatic Image Format



Multispectral Image Format

Position of Principal Point in Level 3 Image

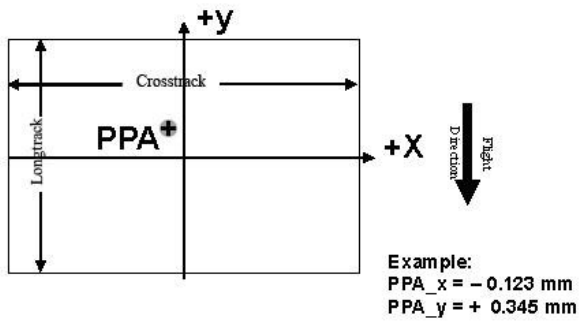
The position of the principal point in the level 3 image depends on the “rotation” setting used in UltraMap during the pan-sharpening step. The exact position relative to the image center is given in the table below as a function of the rotation setting used in UltraMap. The coordinates are specified for clockwise (CW) rotation in steps of 90 degrees, according to the principal point coordinate given on page 4 for high- and low resolution images.

| Image Format | Clockwise Rotation (Degree) | PPA | |
|--------------|-----------------------------|-------|-------|
| | | X | Y |
| Level 2 | - | 0.000 | 0.000 |
| Level 3 | 0 | 0.000 | 0.000 |
| Level 3 | 90 | 0.000 | 0.000 |
| Level 3 | 180 | 0.000 | 0.000 |
| Level 3 | 270 | 0.000 | 0.000 |

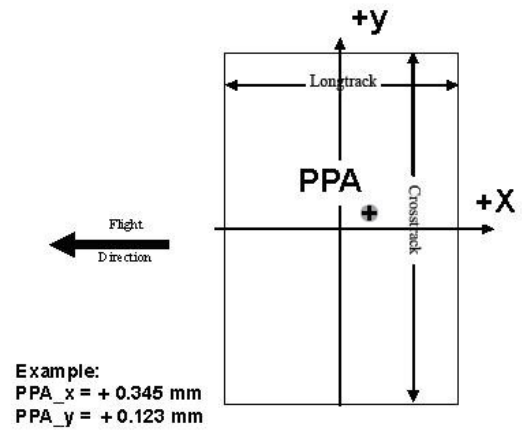


The coordinates in the figure below are only example values to illustrate the effect of image rotation on the principal point position, and do **not** correspond to the camera described in this report.

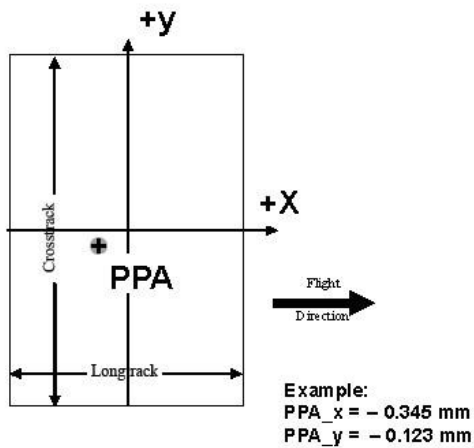
Lvl3, Rotation 0 deg clockwise



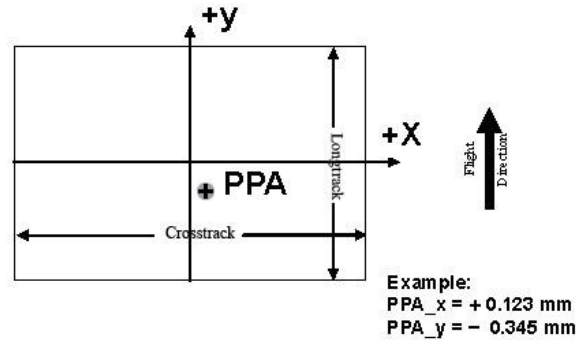
Lvl3, Rotation 90 deg clockwise



Lvl3, Rotation 270 deg clockwise



Lvl3, Rotation 180 deg clockwise





Lens Resolving Power

The following curves show the development of the modulation transfer function across different image heights of the panchromatic cones.

Please note that these values have been calculated and can vary up to 10% with optics from production (especially at high LP's).

The curves are given for the meridional (tangential) and sagittal (radial) component of signals at frequencies of 12.5, 25, 50 and 100 line pairs per millimeter.

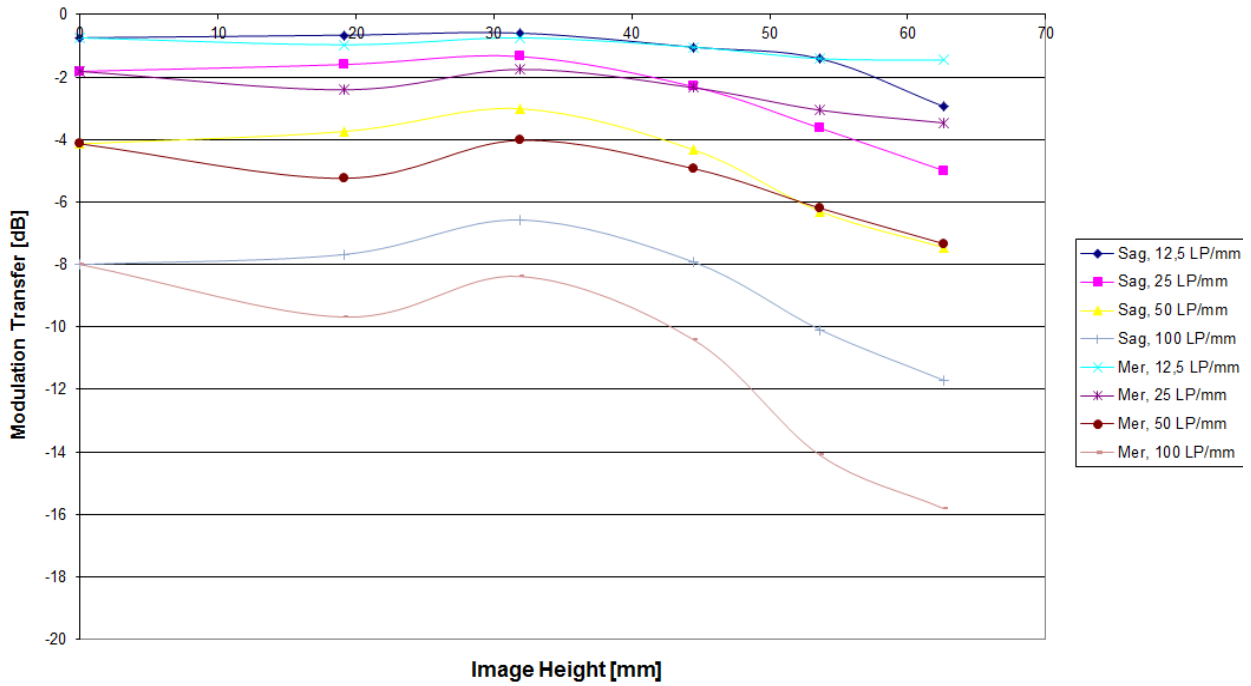
As the MTF is a function of the specific aperture size used, one set of curves is given for each aperture size.

Lens types

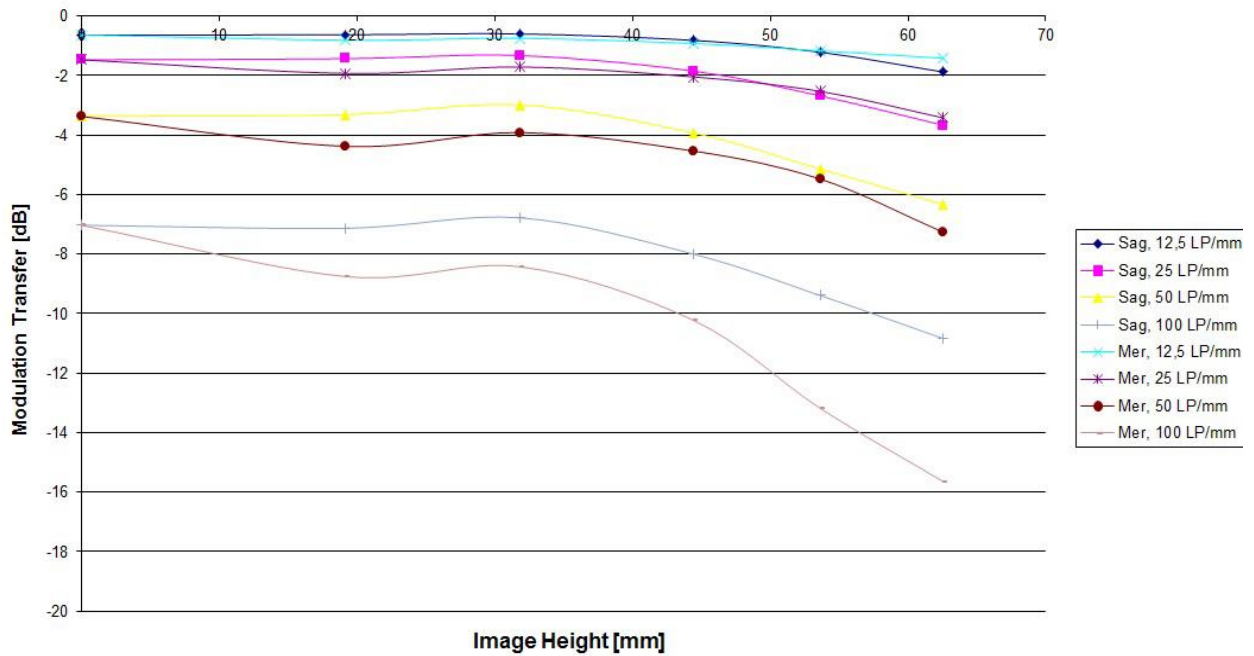
| Cone | Lens |
|------------|-------------------------------------------------------------|
| C0 (PAN) | Qioptic Vexcel HR Digaron 1:5,6/80mm, Qioptic GmbH, Germany |
| C1 (PAN) | Qioptic Vexcel HR Digaron 1:5,6/80mm, Qioptic GmbH, Germany |
| C2 (PAN) | Qioptic Vexcel HR Digaron 1:5,6/80mm, Qioptic GmbH, Germany |
| C3 (PAN) | Qioptic Vexcel HR Digaron 1:5,6/80mm, Qioptic GmbH, Germany |
| C4 (RED) | Qioptic Vexcel HR Digaron 1:4/27mm, Qioptic GmbH, Germany |
| C5 (GREEN) | Qioptic Vexcel HR Digaron 1:4/27mm, Qioptic GmbH, Germany |
| C6 (BLUE) | Qioptic Vexcel HR Digaron 1:4/27mm, Qioptic GmbH, Germany |
| C7 (NIR) | Qioptic Vexcel HR Digaron 1:4/27mm, Qioptic GmbH, Germany |



Modulation versus Image Height - Aperture f/ 5.6

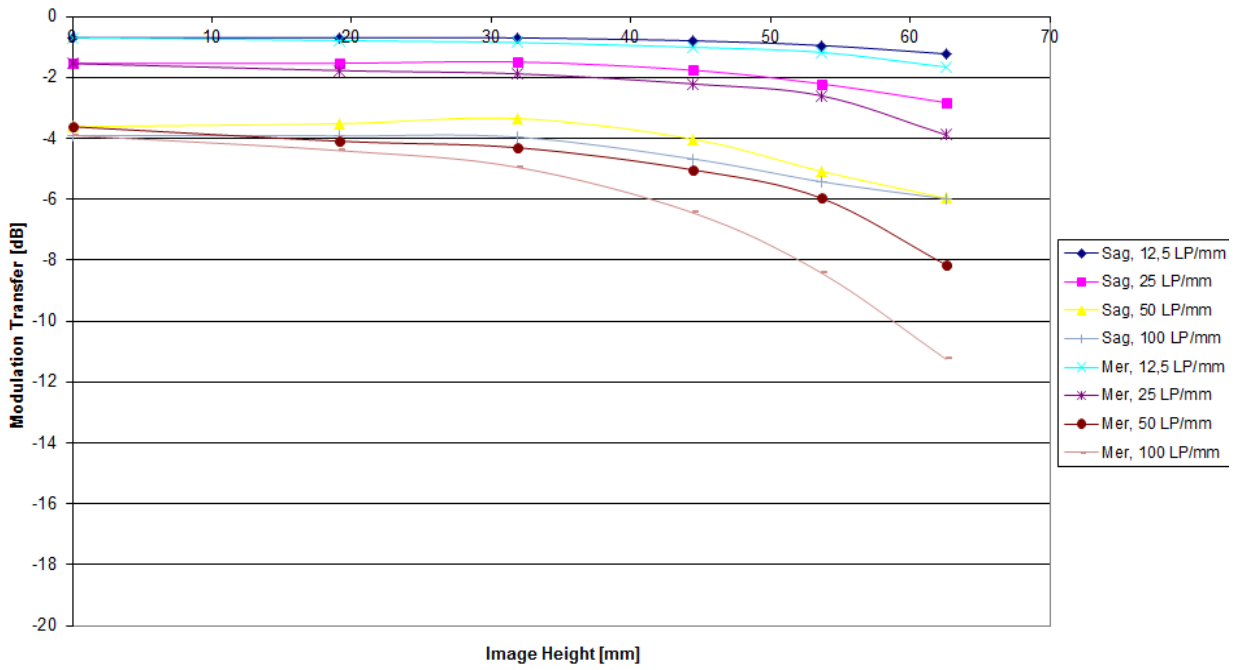


Modulation versus Image Height - Aperture f/ 6.7

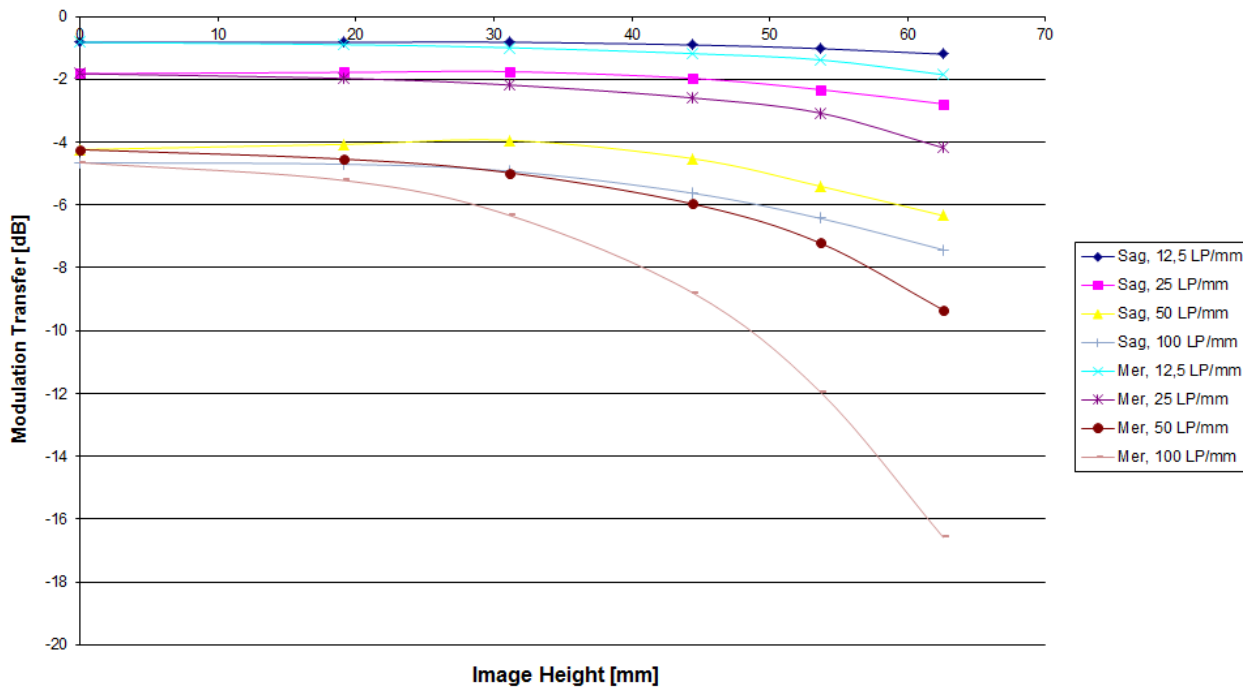




Modulation versus Image Height - Aperture f / 8

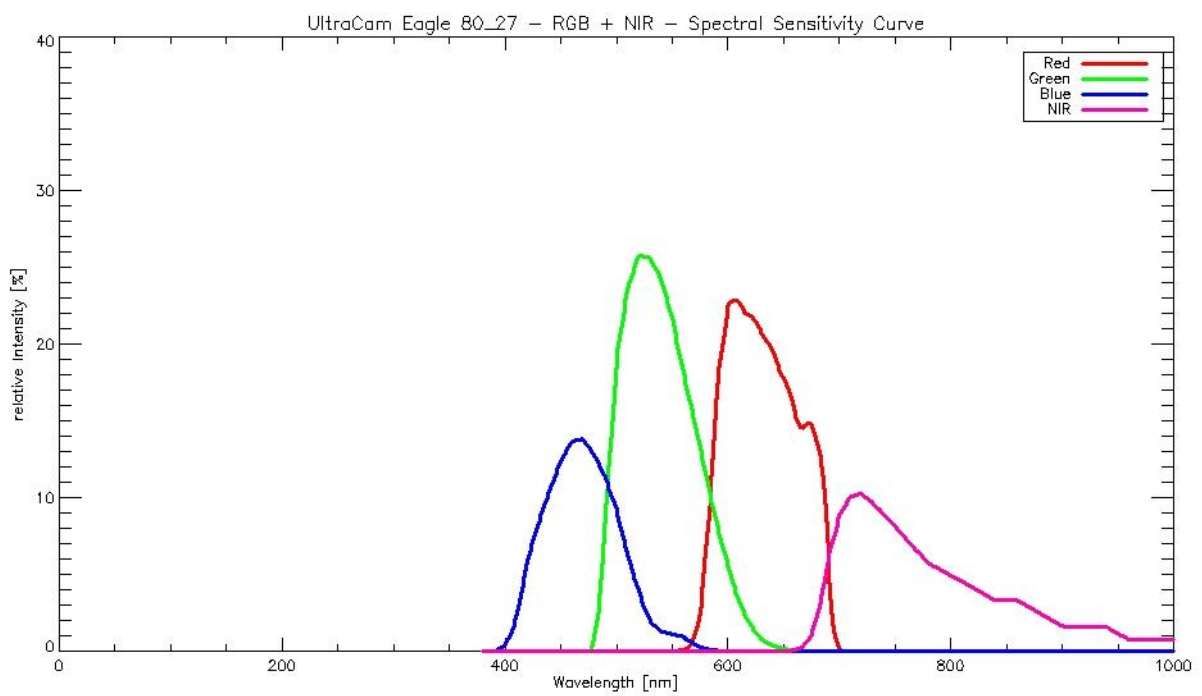
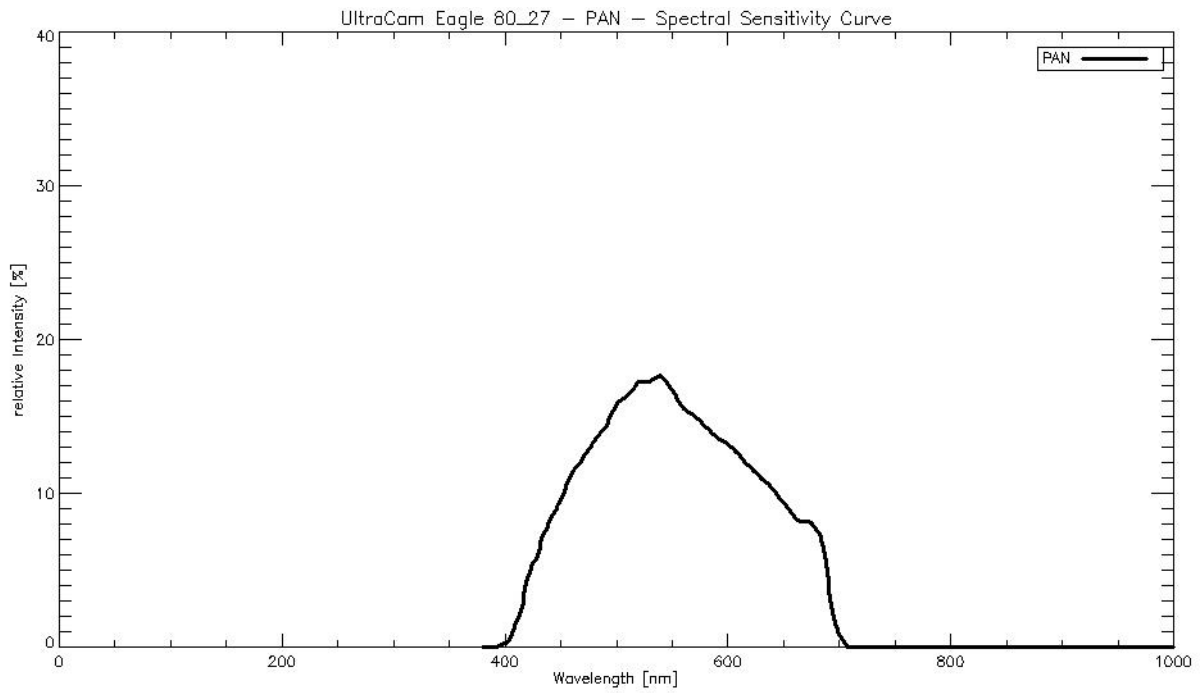


Modulation versus Image Height - Aperture f / 9.5





Spectral Sensitivity





ULTRACAM

Radiometric Calibration

Camera: UltraCam Eagle
Serial: UC-E-1-00817310-f80

| | PAN | R, G, NIR | B |
|----------------|------|-----------|------|
| Used Apertures | F5.6 | F4.8 | F4.8 |
| | F6.5 | F5.4 | F4.8 |
| | F8 | F6.7 | F4.8 |
| | F9.5 | F8 | F5.6 |
| | F11 | F9.5 | F6.7 |
| | F13 | F11 | F8 |
| | F16 | F13 | F9.5 |
| | F22 | F19 | F13 |

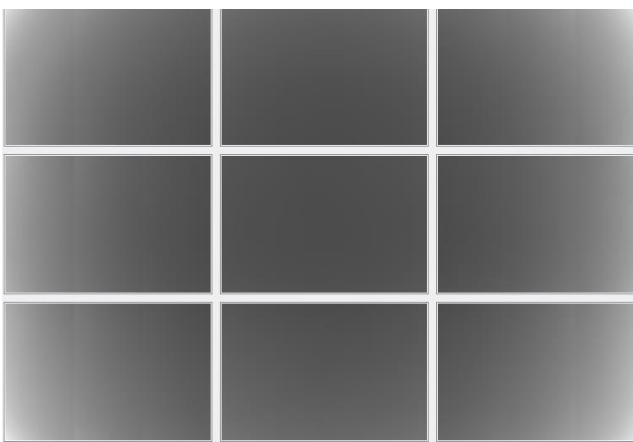
Dead Pixel Report: see Appendix I



Calibration of Vignetting for working Aperture F6.7

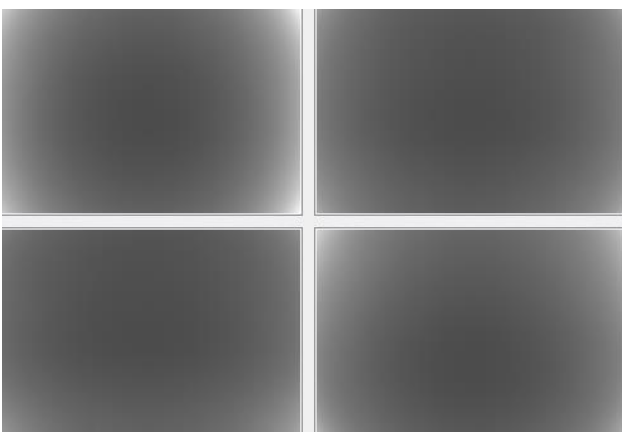
| | PAN | R, G, NIR | B |
|----------|------|-----------|------|
| Aperture | F6.5 | F5.4 | F4.8 |

Graphical Overview of Pan Sensors:



| | | |
|-------|-------|-------|
| 00_00 | 01_00 | 00_01 |
| 02_00 | 03_00 | 02_01 |
| 00_02 | 01_01 | 00_03 |

Graphical Overview of Multispectral Sensors:



| | |
|------------------|-----------------|
| 04_00 (RED) | 06_00 (BLUE) |
| 05_00 (GREEN) | 07_00 (NIR) |



Explanations

Calibration Method:

The radiometric calibration is based on a series of 50 flat field images for each aperture size and sensor. The flat field is illuminated by eight normal light lamps with known spectral illumination curves.

These images are used to calculate the specific sensitivity of each pixel to compensate local as well as global variations in sensitivity. Sensitivity tables are calculated for each sensor and aperture setting, and applied during post processing from level 0 to level 1.

Outlier Pixels that do not have a linear behavior as described in the CCD specifications are marked as defective during the calibration procedure. These pixels are not used or only partially used during post processing and the information is restored by interpolation between the neighborhood pixels surrounding the defective pixels.

Certain pixels that are named Qmax pixels due to the fact that they can only store and transfer charge up to a certain maximum amount are detected in an additional calibration step. These pixels are treated differently during post processing, since their behavior can affect not only single pixel values but whole columns.



ULTRACAM

Shutter Calibration

Camera: UltraCam Eagle
Serial: UC-E-1-00817310-f80

Panchromatic Camera: 4 * Prontor Magnetic 0
Prontor-Werk Alfred Gauthier GmbH, Germany

Multispectral Camera: 4 * Prontor Magnetic 0
Prontor-Werk Alfred Gauthier GmbH, Germany



Calibration of Shutter Release Times:

The shutter release times measured during the calibration describe the time from the moment when the electrical current through the shutter is turned off by the electronics, until the shutter is mechanically closed.

This time is relevant for the exposure control and needs to be known before image recording can take place.

Currently used SRT values (operation values):

| Cone Number | Lens Serial Number | SRT F5.6 [ms] | SRT F6.7 [ms] | SRT F8 [ms] | SRT F9.5 [ms] | SRT F11 [ms] | SRT F13 [ms] | SRT F16 [ms] | SRT F22 [ms] | Measurement Tolerance [ms] |
|-------------|--------------------|---------------|---------------|-------------|---------------|--------------|--------------|--------------|--------------|----------------------------|
| C0 (Pan) | 12 12 20 17 | 12.26 | 12.36 | 13.21 | 13.47 | 13.78 | 14.2 | 14.42 | 14.74 | +/- 0.2 |
| C1 (Pan) | 12 12 20 10 | 11.16 | 11.61 | 12.07 | 12.5 | 12.8 | 12.99 | 13.2 | 13.54 | +/- 0.2 |
| C2 (Pan) | 12 09 99 32 | 10.64 | 11.02 | 11.52 | 11.89 | 12.17 | 12.41 | 12.59 | 12.92 | +/- 0.2 |
| C3 (Pan) | 12 13 59 50 | 11.38 | 11.78 | 12.31 | 12.69 | 13.05 | 13.33 | 13.48 | 13.86 | +/- 0.2 |
| C4 (Red) | 12 12 05 96 | 12.94 | 13.04 | 13.21 | 13.63 | 13.63 | 13.8 | 13.93 | 13.95 | +/- 0.2 |
| C5 (Green) | 12 11 00 64 | 13.27 | 13.34 | 13.61 | 13.9 | 13.94 | 14.13 | 14.22 | 14.47 | +/- 0.2 |
| C6 (Blue) | 12 11 00 72 | 12.72 | 12.72 | 12.67 | 12.91 | 13.12 | 13.47 | 13.62 | 13.96 | +/- 0.2 |
| C7 (NIR) | 12 12 05 95 | 13.12 | 13.24 | 13.53 | 13.77 | 13.79 | 13.87 | 14.17 | 14.17 | +/- 0.2 |



ULTRACAM

Electronics and Sensor Calibration

Camera: UltraCam Eagle
Serial: UC-E-1-00817310-f80

Panchromatic Camera: 9 * FTF7046-M Area CCD Sensor by DALSA
Multispectral Camera: 4 * FTF7046-M Area CCD Sensor by DALSA



Calibration of Negative Substrate Voltage (VNS):

For optimum performance of the DALSA CCD sensors, the negative substrate voltage is adjusted to a value specified by DALSA.

This voltage value is measured to achieve the best anti-blooming performance possible for each particular sensor.

Currently used VNS and VOG values (operation values):

| Cone_Sensor | Sensor Type | Sensor Serial Number | VNS Voltage [V] |
|---------------|-------------|----------------------|-----------------|
| 00_00 | FTF7046-M | 14 9895/033 | 24.00 |
| 00_01 | FTF7046-M | 14 8779/035 | 24.60 |
| 00_02 | FTF7046-M | 14 9895/032 | 24.00 |
| 00_03 | FTF7046-M | 14 8779/043 | 24.60 |
| 01_00 | FTF7046-M | 14 9895/036 | 24.20 |
| 01_01 | FTF7046-M | 14 9895/039 | 24.40 |
| 02_00 | FTF7046-M | 15 1276/027 | 24.40 |
| 02_01 | FTF7046-M | 15 1276/001 | 24.20 |
| 03_00 | FTF7046-M | 14 9895/035 | 24.00 |
| 04_00 (red) | FTF7046-M | 14 9895/034 | 24.00 |
| 05_00 (green) | FTF7046-M | 14 9895/025 | 24.00 |
| 06_00 (blue) | FTF7046-M | 14 9895/029 | 24.00 |
| 07_00 (NIR) | FTF7046-M | 14 9895/027 | 24.00 |



Calibration of Intensity Threshold for Exposure Control:

Each CCD sensor and electronics module varies slightly in global sensitivity and intensity scale.

Therefore the maximum possible intensity of each sensor needs to be measured to evaluate the sensitivity behavior of the CCD and electronics.

This value is used as a threshold for the exposure control dialogue shown in the in-flight user interface of the Eagle.

Currently used Threshold values (operation values):

| Cone_Sensor | Sensor Type | Sensor Serial Number | Intensity Threshold [DN] |
|---------------|-------------|----------------------|--------------------------|
| 00_00 | FTF7046-M | 14 9895/033 | 12940 |
| 00_01 | FTF7046-M | 14 8779/035 | 13390 |
| 00_02 | FTF7046-M | 14 9895/032 | 13360 |
| 00_03 | FTF7046-M | 14 8779/043 | 13100 |
| 01_00 | FTF7046-M | 14 9895/036 | 13480 |
| 01_01 | FTF7046-M | 14 9895/039 | 12950 |
| 02_00 | FTF7046-M | 15 1276/027 | 13490 |
| 02_01 | FTF7046-M | 15 1276/001 | 13930 |
| 03_00 | FTF7046-M | 14 9895/035 | 12730 |
| 04_00 (red) | FTF7046-M | 14 9895/034 | 12760 |
| 05_00 (green) | FTF7046-M | 14 9895/025 | 13480 |
| 06_00 (blue) | FTF7046-M | 14 9895/029 | 13180 |
| 07_00 (NIR) | FTF7046-M | 14 9895/027 | 12980 |



ULTRACAM

Summary

| | |
|-------------------------------------|----------------------------|
| Camera: | UltraCam Eagle |
| Serial: | UC-E-1-00817310-f80 |
| Laboratory Calibration Date: | Mar-14-2022 |
| Camera Revision: | Rev10.00 |
| Date of Report: | Mar-16-2022 |
| Version of Report: | V01 |

The following calibrations have been performed for the above mentioned digital aerial mapping camera:

- Geometric Calibration
- Radiometric Calibration
- Shutter Calibration
- Sensor and Electronics Calibration

This equipment is operating fully within specification as defined by Vexcel Imaging GmbH.

Dr. Michael Gruber
Chief Scientist, Photogrammetry
Vexcel Imaging GmbH

Dipl. Ing. (FH) Helmut Jauk
Senior Project Engineer R&D
Vexcel Imaging GmbH



Appendix I

Dead Pixel Report:

| Sensor number | Anomaly type | X-Coordinate | Y-Coordinate |
|---------------|--------------|--------------|------------------|
| C00-00 | | | |
| | PIXEL: | 2460/ 302 | PIXEL: 3089/ 377 |
| | PIXEL: | 4287/ 507 | PIXEL: 1480/ 586 |
| | PIXEL: | 848/ 829 | PIXEL: 2103/1073 |
| | PIXEL: | 1961/1908 | PIXEL: 2078/1954 |
| | PIXEL: | 6021/2270 | PIXEL: 1207/2374 |
| | PIXEL: | 5109/2677 | PIXEL: 197/2859 |
| | PIXEL: | 4386/3580 | PIXEL: 4530/3636 |
| | PIXEL: | 3554/3932 | PIXEL: 6099/4073 |
| | PIXEL: | 5667/4210 | PIXEL: 5153/4260 |
| | PIXEL: | 335/2679 | PIXEL: 2009/3850 |
| | | | PIXEL: 2851/ 475 |
| | | | PIXEL: 5171/ 667 |
| | | | PIXEL: 2591/1451 |
| | | | PIXEL: 1872/1979 |
| | | | PIXEL: 4728/2529 |
| | | | PIXEL: 6182/3370 |
| | | | PIXEL: 71/3728 |
| | | | PIXEL: 3162/4141 |
| | | | PIXEL: 4735/4296 |
| | | | PIXEL: 2692/4210 |
| | | | PIXEL: 6070/ 742 |
| | | | PIXEL: 469/1666 |
| | | | PIXEL: 2577/2072 |
| | | | PIXEL: 6004/2631 |
| | | | PIXEL: 2748/3400 |
| | | | PIXEL: 1185/3879 |
| | | | PIXEL: 5970/4159 |
| | | | PIXEL: 457/1471 |
| C00-01 | | | |
| | PIXEL: | 5579/ 142 | PIXEL: 5206/ 244 |
| | PIXEL: | 2419/ 489 | PIXEL: 2361/ 659 |
| | PIXEL: | 6662/ 850 | PIXEL: 1753/1356 |
| | PIXEL: | 543/1671 | PIXEL: 1391/1779 |
| | PIXEL: | 6465/2572 | PIXEL: 2756/2639 |
| | PIXEL: | 4711/2991 | PIXEL: 4707/3082 |
| | PIXEL: | 2039/3321 | PIXEL: 4352/3343 |
| | PIXEL: | 6088/3605 | PIXEL: 6343/3809 |
| | PIXEL: | 6106/4059 | PIXEL: 336/4251 |
| | PIXEL: | 5844/4315 | PIXEL: 146/ 105 |
| | PIXEL: | 419/2317 | PIXEL: 5462/2336 |
| | | | PIXEL: 4371/ 353 |
| | | | PIXEL: 1800/ 709 |
| | | | PIXEL: 1753/1357 |
| | | | PIXEL: 3285/1828 |
| | | | PIXEL: 3744/2652 |
| | | | PIXEL: 3375/3160 |
| | | | PIXEL: 3994/3527 |
| | | | PIXEL: 2871/3841 |
| | | | PIXEL: 6210/4253 |
| | | | PIXEL: 4765/ 927 |
| | | | PIXEL: 372/4627 |
| | | | PIXEL: 5392/ 765 |
| | | | PIXEL: 3655/1512 |
| | | | PIXEL: 4397/2115 |
| | | | PIXEL: 2159/2855 |
| | | | PIXEL: 5437/3203 |
| | | | PIXEL: 587/3567 |
| | | | PIXEL: 6193/3988 |
| | | | PIXEL: 2025/4258 |
| | | | PIXEL: 4765/ 928 |
| C00-02 | | | |
| | PIXEL: | 6643/ 77 | PIXEL: 1571/ 435 |
| | PIXEL: | 6778/ 946 | PIXEL: 1009/1016 |
| | PIXEL: | 2979/1481 | PIXEL: 4202/1939 |
| | PIXEL: | 3714/2240 | PIXEL: 1784/2376 |
| | PIXEL: | 2341/3400 | PIXEL: 6301/3794 |
| | PIXEL: | 5407/4369 | PIXEL: 1916/ 81 |
| | PIXEL: | 2961/1968 | PIXEL: 472/2268 |
| | PIXEL: | 79/3008 | PIXEL: 1219/3582 |
| | | | PIXEL: 88/ 494 |
| | | | PIXEL: 1206/1105 |
| | | | PIXEL: 1212/2067 |
| | | | PIXEL: 5278/2863 |
| | | | PIXEL: 1761/3992 |
| | | | PIXEL: 601/ 245 |
| | | | PIXEL: 4203/2299 |
| | | | PIXEL: 2674/4138 |
| | | | PIXEL: 2746/1402 |
| | | | PIXEL: 2509/2122 |
| | | | PIXEL: 676/3357 |
| | | | PIXEL: 3862/4061 |
| | | | PIXEL: 110/ 380 |
| | | | PIXEL: 25/2499 |



C00-03

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 976/ 62 | PIXEL: 6169/ 72 | PIXEL: 6421/ 132 | |
| PIXEL: 3124/ 195 | PIXEL: 2327/ 314 | PIXEL: 2425/ 371 | PIXEL: 1612/ 625 |
| PIXEL: 1025/1018 | PIXEL: 4203/1191 | PIXEL: 6542/1271 | PIXEL: 2162/1710 |
| PIXEL: 6619/1852 | PIXEL: 232/2593 | PIXEL: 4204/2640 | PIXEL: 5415/2792 |
| PIXEL: 6405/2793 | PIXEL: 410/3105 | PIXEL: 2575/3150 | PIXEL: 2575/3151 |
| PIXEL: 6543/3273 | PIXEL: 5432/3599 | PIXEL: 1106/3672 | PIXEL: 4235/3814 |
| PIXEL: 5131/4323 | PIXEL: 988/1349 | PIXEL: 682/2028 | PIXEL: 684/2028 |
| PIXEL: 440/2777 | PIXEL: 5865/3464 | PIXEL: 2616/3795 | PIXEL: 3411/3852 |
| PIXEL: 3412/3852 | PIXEL: 3412/3853 | PIXEL: 1364/3897 | PIXEL: 3110/4136 |
| PIXEL: 6669/4583 | PIXEL: 6669/4582 | PIXEL: 6681/4575 | PIXEL: 103/4498 |
| PIXEL: 104/4498 | PIXEL: 103/4499 | PIXEL: 104/4499 | PIXEL: 105/4499 |
| PIXEL: 105/4498 | | | |

C01-00

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 6258/ 124 | | | |
| PIXEL: 4479/ 264 | PIXEL: 2831/1005 | PIXEL: 1090/1041 | PIXEL: 5974/1199 |
| PIXEL: 4531/1286 | PIXEL: 2919/1688 | PIXEL: 603/1740 | PIXEL: 6474/1775 |
| PIXEL: 5430/1861 | PIXEL: 662/2061 | PIXEL: 803/2145 | PIXEL: 1755/2196 |
| PIXEL: 2195/2902 | PIXEL: 6817/2959 | PIXEL: 6719/3356 | PIXEL: 2984/3465 |
| PIXEL: 4928/3542 | PIXEL: 5287/3773 | PIXEL: 1854/3892 | PIXEL: 1447/4009 |
| PIXEL: 6362/4080 | PIXEL: 5456/ 704 | PIXEL: 5455/ 705 | PIXEL: 5456/ 705 |
| PIXEL: 5455/ 706 | PIXEL: 5456/ 706 | PIXEL: 5808/2069 | PIXEL: 5809/2069 |
| PIXEL: 5808/2070 | PIXEL: 5809/2070 | PIXEL: 905/3920 | PIXEL: 906/3920 |

C01-01

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 4926/ 25 | PIXEL: 5365/ 245 | | |
| PIXEL: 3157/ 247 | PIXEL: 2169/ 252 | PIXEL: 2700/ 261 | PIXEL: 684/ 313 |
| PIXEL: 5350/ 463 | PIXEL: 466/ 520 | PIXEL: 3743/ 676 | PIXEL: 3213/ 742 |
| PIXEL: 436/ 749 | PIXEL: 685/ 826 | PIXEL: 1641/ 888 | PIXEL: 936/ 918 |
| PIXEL: 3393/1407 | PIXEL: 1442/1436 | PIXEL: 4530/1634 | PIXEL: 4156/1680 |
| PIXEL: 1066/1809 | PIXEL: 2089/1967 | PIXEL: 5389/2041 | PIXEL: 3819/2327 |
| PIXEL: 4919/2610 | PIXEL: 3415/2727 | PIXEL: 3755/3104 | PIXEL: 2541/3225 |
| PIXEL: 4435/3244 | PIXEL: 3010/3287 | PIXEL: 2203/3341 | PIXEL: 4300/3341 |
| PIXEL: 6534/3431 | PIXEL: 3492/4404 | PIXEL: 2631/4510 | PIXEL: 4314/ 187 |
| PIXEL: 4314/ 188 | PIXEL: 5601/ 941 | PIXEL: 2737/ 951 | PIXEL: 2738/ 951 |
| PIXEL: 6893/3459 | PIXEL: 6894/3459 | | |

C02-00

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 138/ 38 | PIXEL: 6787/ 530 | PIXEL: 6202/ 614 | PIXEL: 5673/ 723 |
| PIXEL: 943/ 750 | PIXEL: 6702/1662 | PIXEL: 1069/2696 | PIXEL: 6052/3016 |
| PIXEL: 965/3184 | PIXEL: 1586/3188 | PIXEL: 2729/3200 | PIXEL: 3736/3569 |
| PIXEL: 6766/3729 | PIXEL: 5233/3736 | PIXEL: 5244/3810 | PIXEL: 639/3872 |
| PIXEL: 5851/3956 | PIXEL: 6340/4610 | PIXEL: 2724/ 717 | PIXEL: 3804/4541 |
| PIXEL: 3804/4543 | PIXEL: 3804/4542 | PIXEL: 3805/4541 | PIXEL: 3872/4469 |
| PIXEL: 3873/4469 | PIXEL: 3874/4469 | PIXEL: 3875/4469 | PIXEL: 3876/4468 |
| PIXEL: 3876/4469 | PIXEL: 3877/4469 | PIXEL: 3872/4470 | PIXEL: 3873/4470 |
| PIXEL: 3874/4470 | | | |



C02-01

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 3143/ 222 | | | |
| PIXEL: 1908/ 745 | PIXEL: 3819/1217 | PIXEL: 5180/1748 | PIXEL: 4105/1865 |
| PIXEL: 5180/2364 | PIXEL: 1789/2732 | PIXEL: 6256/2790 | PIXEL: 6853/3088 |
| PIXEL: 4502/3519 | PIXEL: 2335/3815 | PIXEL: 2717/4510 | PIXEL: 2527/ 222 |
| PIXEL: 5219/2739 | PIXEL: 5219/2740 | PIXEL: 255/4542 | PIXEL: 255/4540 |
| PIXEL: 255/4541 | PIXEL: 254/4542 | PIXEL: 254/4543 | PIXEL: 253/4543 |
| PIXEL: 253/4544 | PIXEL: 254/4545 | PIXEL: 254/4544 | PIXEL: 255/4545 |
| PIXEL: 256/4545 | PIXEL: 257/4545 | PIXEL: 257/4544 | PIXEL: 257/4543 |
| PIXEL: 256/4544 | PIXEL: 255/4544 | PIXEL: 256/4543 | PIXEL: 255/4543 |
| PIXEL: 256/4542 | PIXEL: 315/4548 | | |

C03-00

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 1031/ 110 | PIXEL: 6366/ 230 | PIXEL: 4810/ 395 | PIXEL: 659/ 506 |
| PIXEL: 6602/ 862 | PIXEL: 43/ 962 | PIXEL: 316/1020 | PIXEL: 5297/1090 |
| PIXEL: 4218/1196 | PIXEL: 2440/1451 | PIXEL: 1552/1614 | PIXEL: 6284/1907 |
| PIXEL: 2159/1982 | PIXEL: 5065/1998 | PIXEL: 980/2048 | PIXEL: 6086/2263 |
| PIXEL: 5417/2406 | PIXEL: 6595/3143 | PIXEL: 5619/3280 | PIXEL: 4214/3527 |
| PIXEL: 4352/3594 | PIXEL: 4044/3608 | PIXEL: 6175/3652 | PIXEL: 4521/3668 |
| PIXEL: 3767/3710 | PIXEL: 2551/3767 | PIXEL: 4490/4121 | PIXEL: 5914/4310 |
| PIXEL: 4302/4343 | PIXEL: 5469/4390 | PIXEL: 5025/4403 | PIXEL: 6371/4475 |
| PIXEL: 4794/4594 | PIXEL: 1794/ 894 | PIXEL: 589/1454 | PIXEL: 2706/1478 |
| PIXEL: 2706/1479 | PIXEL: 4561/1933 | PIXEL: 4562/1933 | PIXEL: 4564/1949 |
| PIXEL: 4548/3784 | | | |

C04-00

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 346/ 43 | | | |
| PIXEL: 3329/ 183 | PIXEL: 572/ 217 | PIXEL: 1254/ 266 | PIXEL: 6679/ 445 |
| PIXEL: 4225/ 462 | PIXEL: 6425/ 487 | PIXEL: 1266/ 578 | PIXEL: 4831/ 678 |
| PIXEL: 4669/ 727 | PIXEL: 3069/ 966 | PIXEL: 2063/1012 | PIXEL: 1468/1152 |
| PIXEL: 3125/1745 | PIXEL: 3293/1768 | PIXEL: 6405/1804 | PIXEL: 1655/1939 |
| PIXEL: 2121/2043 | PIXEL: 1753/2071 | PIXEL: 3143/2132 | PIXEL: 2247/2237 |
| PIXEL: 3246/2704 | PIXEL: 1092/2874 | PIXEL: 3166/3288 | PIXEL: 2285/3317 |
| PIXEL: 3133/3624 | PIXEL: 5701/4245 | PIXEL: 6024/4302 | PIXEL: 1261/4379 |
| PIXEL: 24/4570 | PIXEL: 6673/ 54 | PIXEL: 6357/ 342 | PIXEL: 1314/2815 |
| PIXEL: 1315/2815 | PIXEL: 1314/2816 | PIXEL: 1315/2816 | PIXEL: 3799/3406 |
| PIXEL: 3798/3407 | PIXEL: 3797/3408 | PIXEL: 5773/3875 | |

C05-00

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 1820/ 158 | PIXEL: 5519/ 690 | PIXEL: 2284/ 932 | |
| PIXEL: 6597/ 988 | PIXEL: 5975/1049 | PIXEL: 4021/1236 | PIXEL: 425/1268 |
| PIXEL: 3642/1761 | PIXEL: 2327/1788 | PIXEL: 1970/1942 | PIXEL: 2061/2239 |
| PIXEL: 1748/2571 | PIXEL: 3924/2855 | PIXEL: 1858/3051 | PIXEL: 1858/3064 |
| PIXEL: 6573/3073 | PIXEL: 1858/3092 | PIXEL: 1858/3094 | PIXEL: 1858/3104 |
| PIXEL: 6776/3114 | PIXEL: 1858/3119 | PIXEL: 1858/3135 | PIXEL: 1858/3151 |
| PIXEL: 1858/3154 | PIXEL: 1858/3156 | PIXEL: 1858/3179 | PIXEL: 1858/3186 |
| PIXEL: 1858/3200 | PIXEL: 1858/3219 | PIXEL: 1858/3224 | PIXEL: 1858/3275 |
| PIXEL: 1858/3278 | PIXEL: 1858/3279 | PIXEL: 1858/3310 | PIXEL: 1858/3350 |
| PIXEL: 1858/3361 | PIXEL: 1858/3364 | PIXEL: 1858/3382 | PIXEL: 50/3413 |
| PIXEL: 1858/3424 | PIXEL: 1858/3442 | PIXEL: 1858/3511 | PIXEL: 1858/3533 |
| PIXEL: 1858/3559 | PIXEL: 1858/3562 | PIXEL: 1858/3565 | PIXEL: 1858/3570 |



| | | | |
|------------------|------------------|-------------------|------------------|
| PIXEL: 1858/3571 | PIXEL: 1858/3578 | PIXEL: 1858/3608 | PIXEL: 1858/3614 |
| PIXEL: 1858/3658 | PIXEL: 1858/3691 | PIXEL: 1858/3707 | PIXEL: 1858/3741 |
| PIXEL: 1858/3756 | PIXEL: 1858/3774 | PIXEL: 1858/3778 | PIXEL: 1858/3786 |
| PIXEL: 1858/3810 | PIXEL: 1858/3835 | PIXEL: 1858/3846 | PIXEL: 1858/3889 |
| PIXEL: 1858/3905 | PIXEL: 1858/3931 | PIXEL: 1858/3944 | PIXEL: 1858/3990 |
| PIXEL: 1858/3994 | PIXEL: 252/3999 | PIXEL: 1858/4017 | PIXEL: 1858/4044 |
| PIXEL: 1858/4060 | PIXEL: 1858/4120 | PIXEL: 1858/4150 | PIXEL: 1858/4206 |
| PIXEL: 1858/4220 | PIXEL: 5031/4222 | PIXEL: 1858/4251 | PIXEL: 1858/4309 |
| PIXEL: 4637/4336 | PIXEL: 1858/4359 | PIXEL: 1858/4361 | PIXEL: 1858/4397 |
| PIXEL: 1858/4407 | PIXEL: 1858/4442 | PIXEL: 1858/4461 | PIXEL: 1858/4477 |
| PIXEL: 3594/4481 | PIXEL: 1858/4496 | PIXEL: 1858/4513 | PIXEL: 1858/4524 |
| PIXEL: 1858/4551 | PIXEL: 1858/4553 | PIXEL: 1858/4570 | PIXEL: 1858/4575 |
| PIXEL: 2159/4577 | PIXEL: 6650/4577 | PIXEL: 1858/4578 | PIXEL: 1858/4581 |
| PIXEL: 1858/4602 | PIXEL: 1858/4603 | PIXEL: 1858/4613 | PIXEL: 5473/ 89 |
| PIXEL: 5473/ 90 | PIXEL: 3543/1527 | COLUMN: 1858/3052 | |

C06-00

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 3783/ 110 | PIXEL: 4626/ 197 | PIXEL: 6257/ 346 | |
| PIXEL: 6312/ 529 | PIXEL: 6635/ 609 | PIXEL: 3636/1079 | PIXEL: 3889/1358 |
| PIXEL: 663/1608 | PIXEL: 6079/1811 | PIXEL: 3134/2087 | PIXEL: 640/2112 |
| PIXEL: 1459/2120 | PIXEL: 6002/2193 | PIXEL: 2492/2529 | PIXEL: 211/2702 |
| PIXEL: 4545/2985 | PIXEL: 3705/3155 | PIXEL: 298/3162 | PIXEL: 3371/3381 |
| PIXEL: 464/3581 | PIXEL: 5881/3612 | PIXEL: 2531/3777 | PIXEL: 3850/3925 |
| PIXEL: 3436/4014 | PIXEL: 5968/4379 | PIXEL: 789/ 226 | PIXEL: 4445/ 350 |
| PIXEL: 2934/1002 | PIXEL: 5607/1230 | PIXEL: 976/1842 | PIXEL: 294/2402 |
| PIXEL: 227/2768 | PIXEL: 536/2891 | PIXEL: 589/2919 | PIXEL: 6534/3741 |
| PIXEL: 645/3949 | PIXEL: 601/4107 | PIXEL: 1060/4111 | PIXEL: 6703/4412 |
| PIXEL: 6933/4579 | | | |

C07-00

| | | | |
|------------------|------------------|------------------|------------------|
| PIXEL: 2611/ 149 | | | |
| PIXEL: 1838/ 384 | PIXEL: 1953/ 988 | PIXEL: 4091/1137 | PIXEL: 1571/1152 |
| PIXEL: 1985/1265 | PIXEL: 2106/1326 | PIXEL: 3774/1484 | PIXEL: 3407/1534 |
| PIXEL: 730/1679 | PIXEL: 2666/1955 | PIXEL: 3856/2078 | PIXEL: 3849/2815 |
| PIXEL: 1753/2871 | PIXEL: 2034/2960 | PIXEL: 3481/3232 | PIXEL: 2453/3474 |
| PIXEL: 675/3580 | PIXEL: 1245/3828 | PIXEL: 6326/3978 | PIXEL: 5946/4084 |
| PIXEL: 5228/4276 | PIXEL: 291/4313 | PIXEL: 383/ 166 | PIXEL: 3814/1293 |
| PIXEL: 6025/1928 | PIXEL: 4628/2835 | PIXEL: 4629/2835 | PIXEL: 3813/3692 |
| PIXEL: 3814/3692 | | | |



Notes

COLUMN anomaly: all pixels below the Qmax detector at location (X,Y) may be affected.

PIXEL anomaly: single detector at location (X,Y) is not functioning within normal range

The Level0 coordinates exclude the two leftmost pixels containing the line index: the corresponding pixel can therefore be located at column (X+2,Y).

Appendix II

Calibration and Modification Dates

| Type of Calibration | Laboratory Calibration Date | Modification Date | Modification Reason |
|------------------------------------|-----------------------------|-------------------|---------------------|
| Geometric Calibration | 14.Mar.2022 | | |
| Radiometric Calibration | 14.Mar.2022 | | |
| Shutter Calibration | 14.Mar.2022 | | |
| Electronics and Sensor Calibration | 14.Mar.2022 | | |



Note: The above-mentioned Laboratory Calibration Dates represent the dates the camera was calibrated in one of our calibration labs for a full Laboratory Calibration. The Modification date represents a date on which the calibration has been modified due to a calibration enhancement or part exchange. It is an additional information and does not replace the Laboratory Calibration date in any way. With the Modification Reason, always the last modification to the calibration is highlighted.