VEXCEL
IMAGING

ULTRACAM

Calibration Report

Bahia, Brasil 2013

Photo on page 1 courtesy of Hiparc Geotecnologia, Brasil

www.hiparc.com

UltraCam Lp, GSD25 cm, RGB

ULTRACAM

Geometric Calibration

Camera:	**UltraCam Eagle**
Serial:	**UC-E-1-50319383-f80**
Panchromatic Camera:	**ck = 79.800 mm**
Multispectral Camera:	**ck = 79.800 mm**
PPA Information:	**X: 0.000 mm**
	Y: 0.000 mm
Calibration Date:	**May-30-2019**
Date of Report:	**June-10-2019**
Camera Revision:	**Rev04.00**
Version of Report:	**V04**

Panchromatic Camera

Large Format Panchromatic Output Image

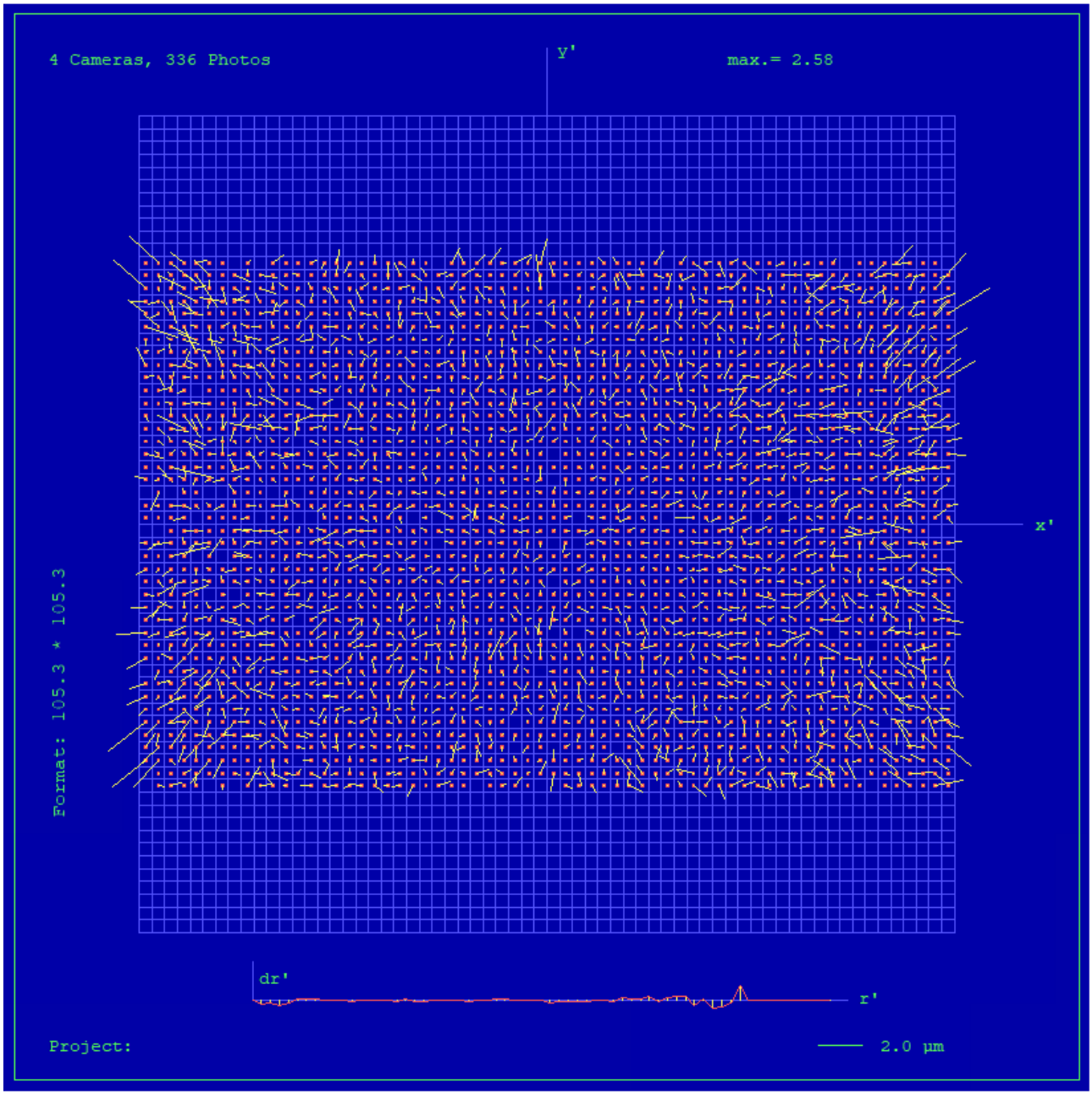
Image Format	long track cross track	68.016mm 104.052mm	13080pixel 20010pixel
Image Extent		(-34.008, -52.026)mm	(34.008, 52.026)mm
Pixel Size		5.200µm*5.200µm	
Focal Length	ck	79.800mm	± 0.002mm
Principal Point (Level 2)	X_ppa	0.000mm	± 0.002mm
	Y_ppa	0.000mm	± 0.002mm
Lens Distortion	Remaining Distortion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

Multispectral Camera

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

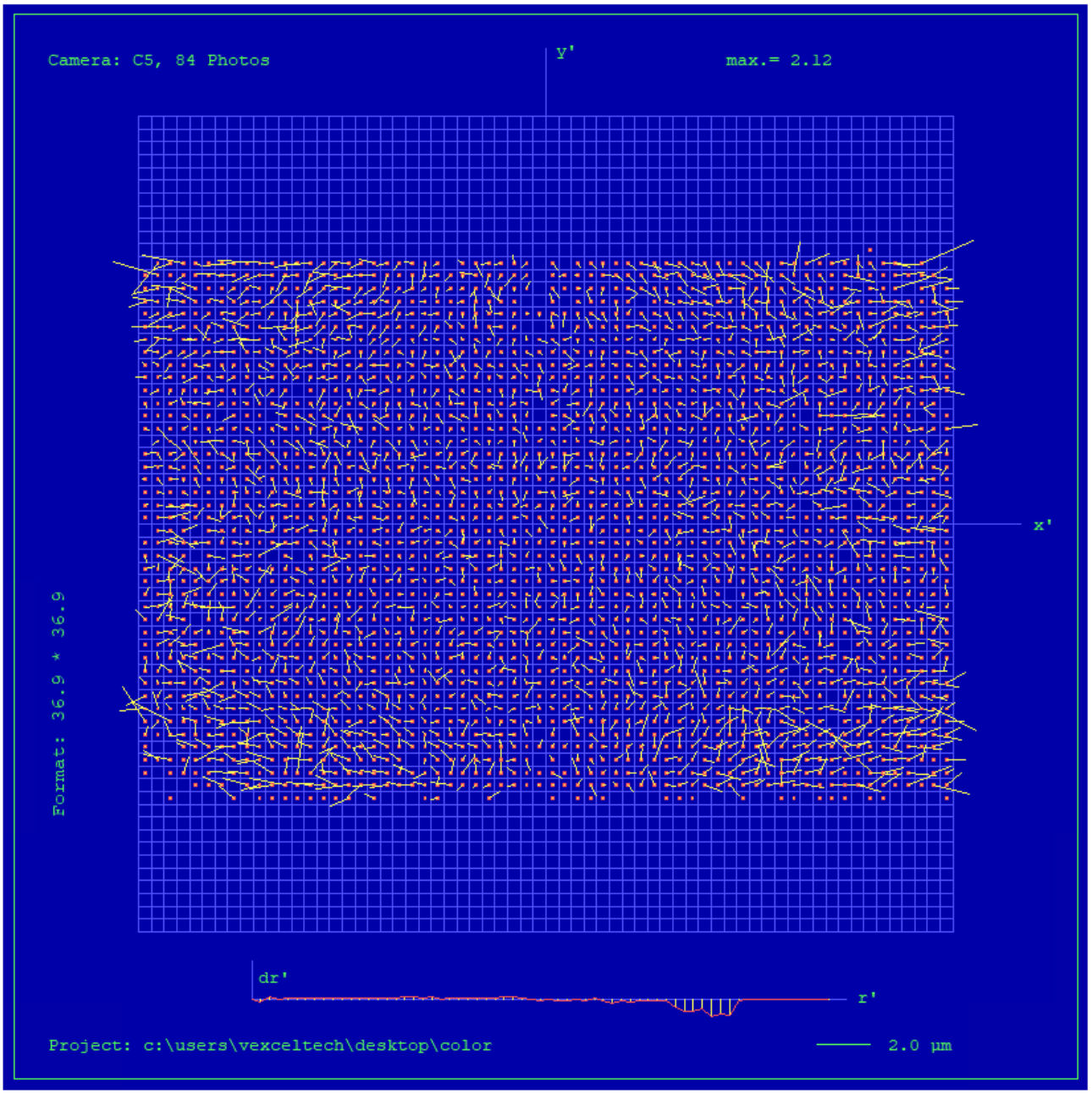
Image Format	long track cross track	68.016mm 104.052mm	4360pixel 6670pixel
Image Extent		(-34.008, -52.026)mm	(34.008, 52.026)mm
Pixel Size		15.600µm*15.600µm	
Focal Length	ck	79.800mm	± 0.002mm
Principal Point (Level 2)	X_ppa	0.000mm	± 0.002mm
	Y_ppa	0.000mm	± 0.002mm
Lens Distortion	Remaining Distortion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

Full Panchromatic Image, Residual Error Diagram



Residual Error (RMS): **0.66 µm**

Green Cone (Cone 5), Residual Error Diagram



Residual Error (RMS): **0.59 µm**

Explanations

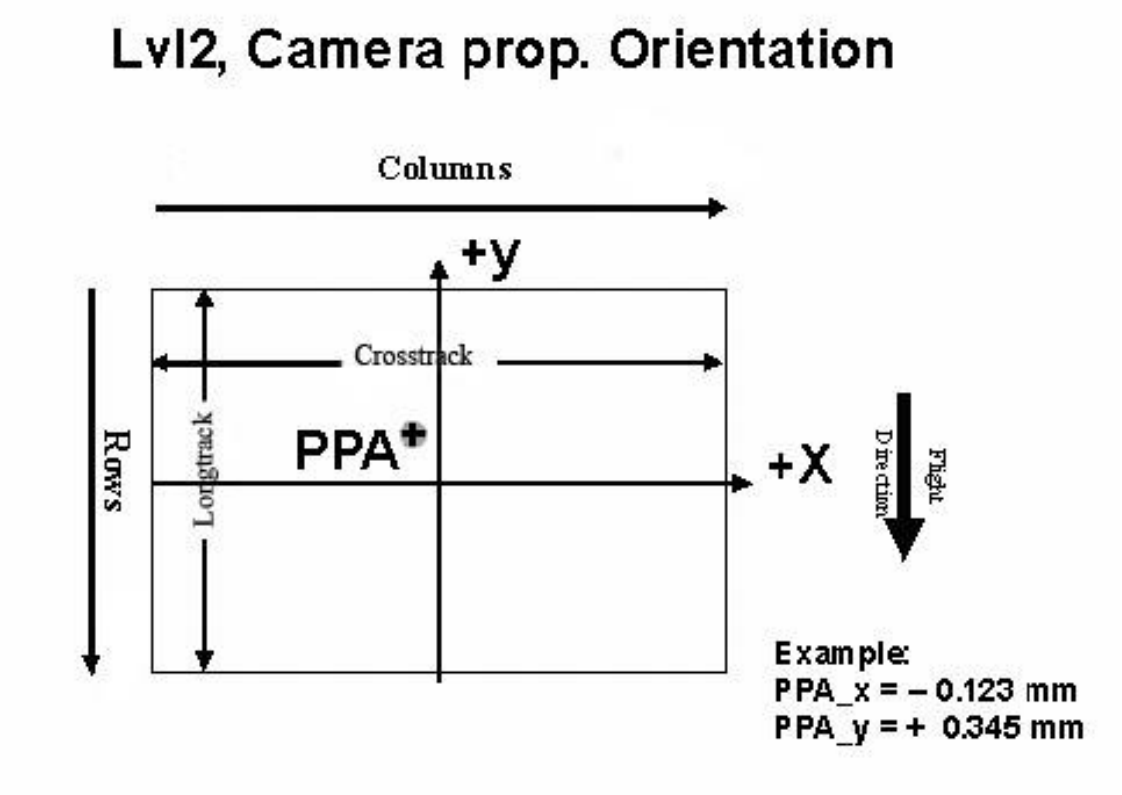
Calibration Method:

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)

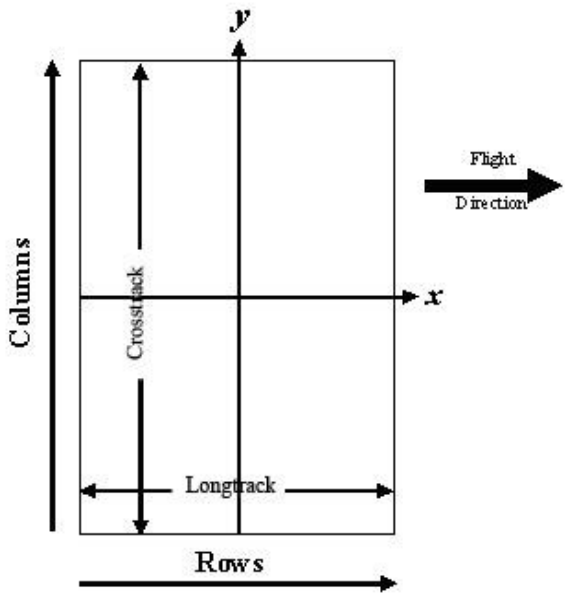
Level 2 Image Coordinate System:



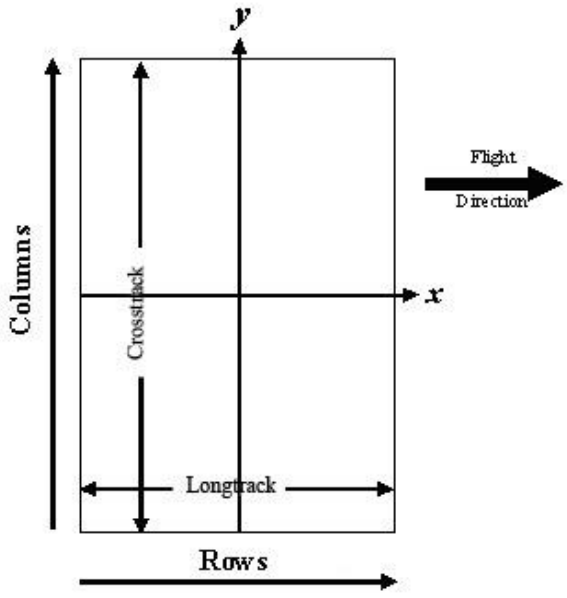
The image coordinate system of the Level 2 images is shown in the above figure. The basic image format and coordinate of the principal point in the level 2 image is given on page 4 of this report.

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

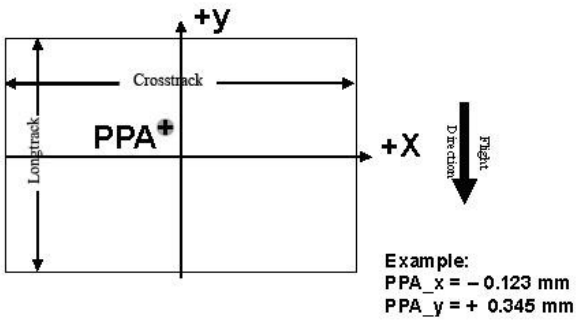
Position of Principal Point in Level 3 Image

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

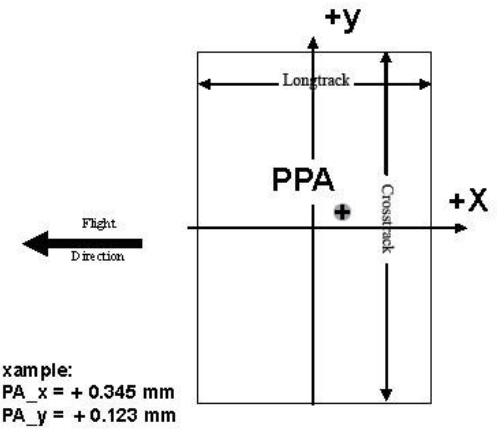
The coordinates in the figure below are only example values to illustrate the effect of image rotation on the principal point position, and do **not** correspond to the camera described in this report.

Lvl3, Rotation 0 deg clockwise



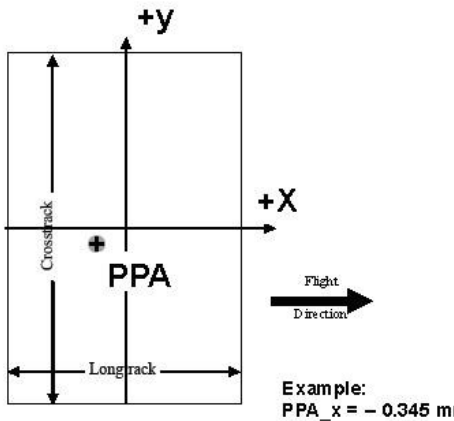
Example:
PPA_x = – 0.123 mm
PPA_y = + 0.345 mm

Lvl3, Rotation 90 deg clockwise



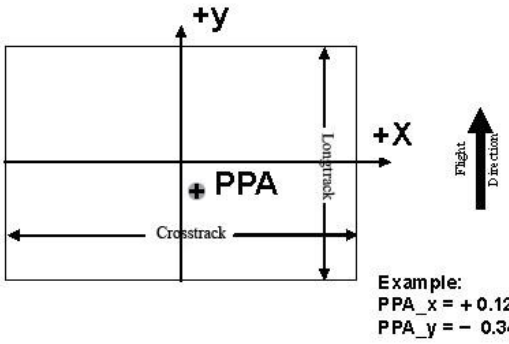
Example:
PPA_x = + 0.345 mm
PPA_y = + 0.123 mm

Lvl3, Rotation 270 deg clockwise



Example:
PPA_x = – 0.345 mm
PPA_y = – 0.123 mm

Lvl3, Rotation 180 deg clockwise



Example:
PPA_x = + 0.123 mm
PPA_y = – 0.345 mm

Lens Resolving Power

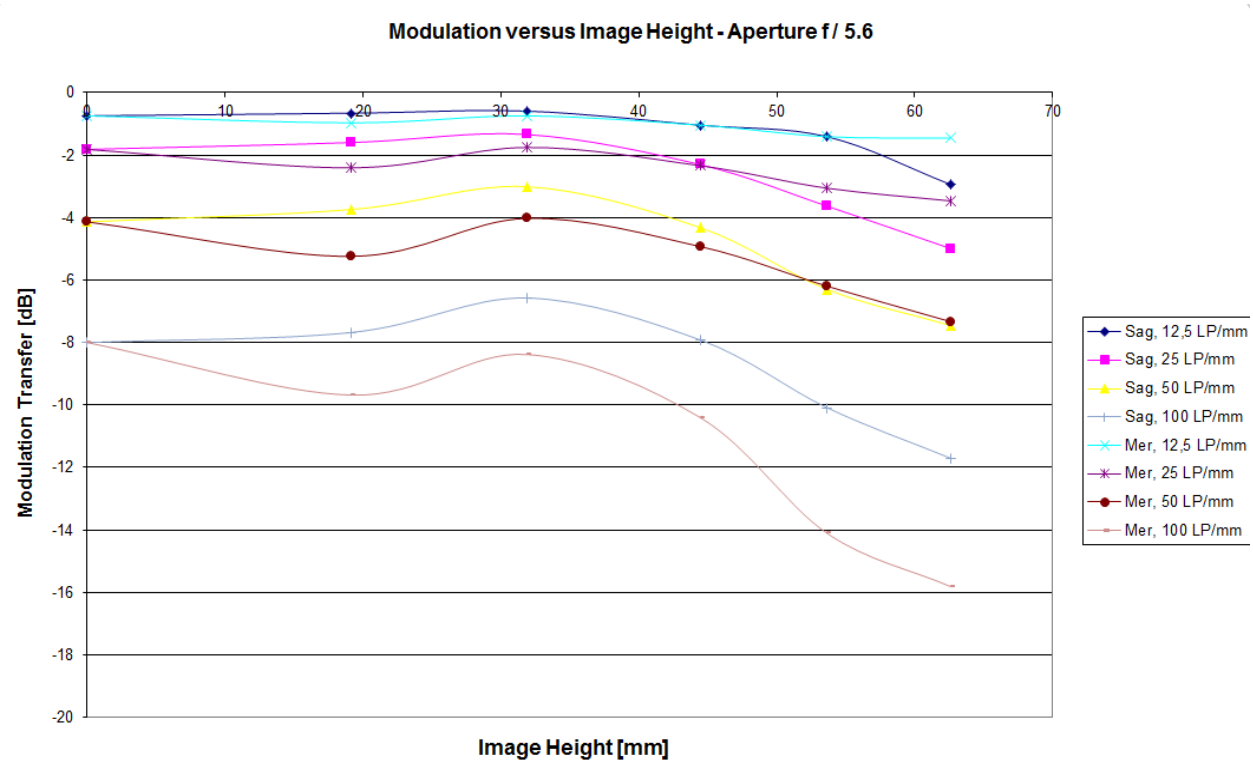
The following curves show the development of the modulation transfer function across different image heights of the panchromatic cones.
Please note that these values have been calculated and can vary up to 10% with optics from production (especially at high LP's).

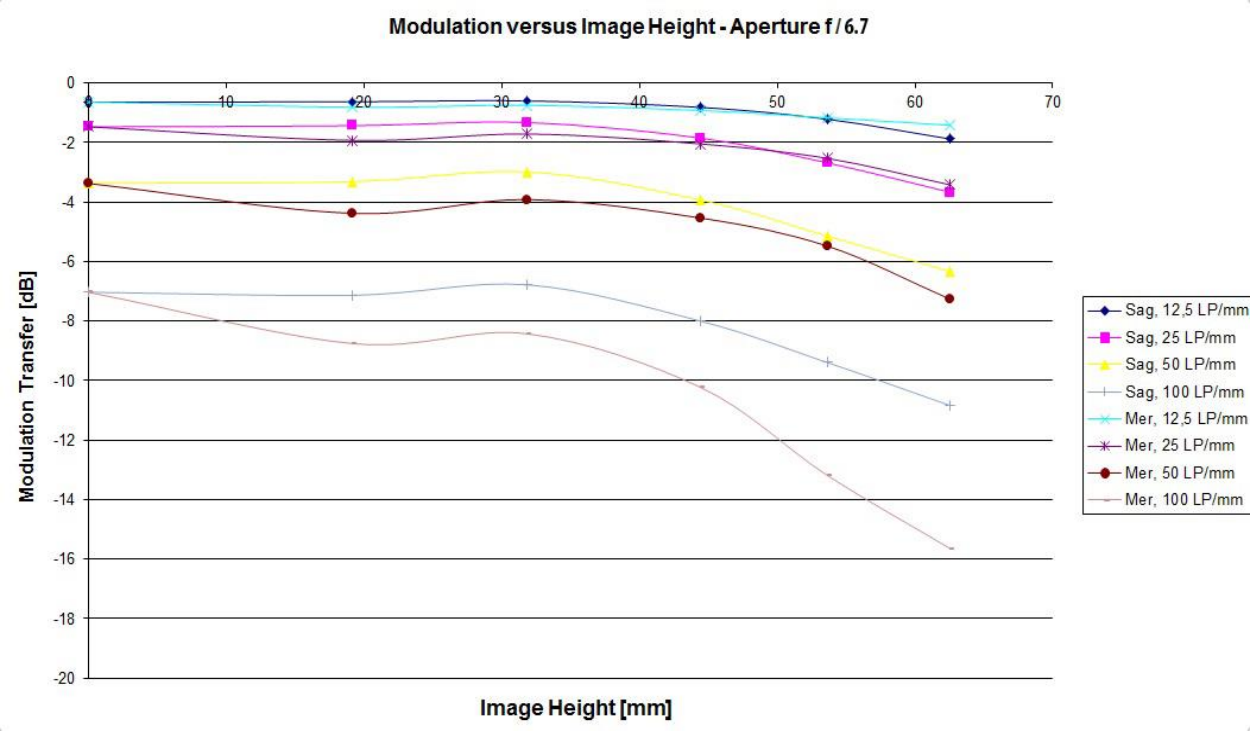
The curves are given for the meridonial (tangential) and sagital (radial) component of signals at frequencies of 12.5, 25, 50 and 100 line pairs per millimeter.

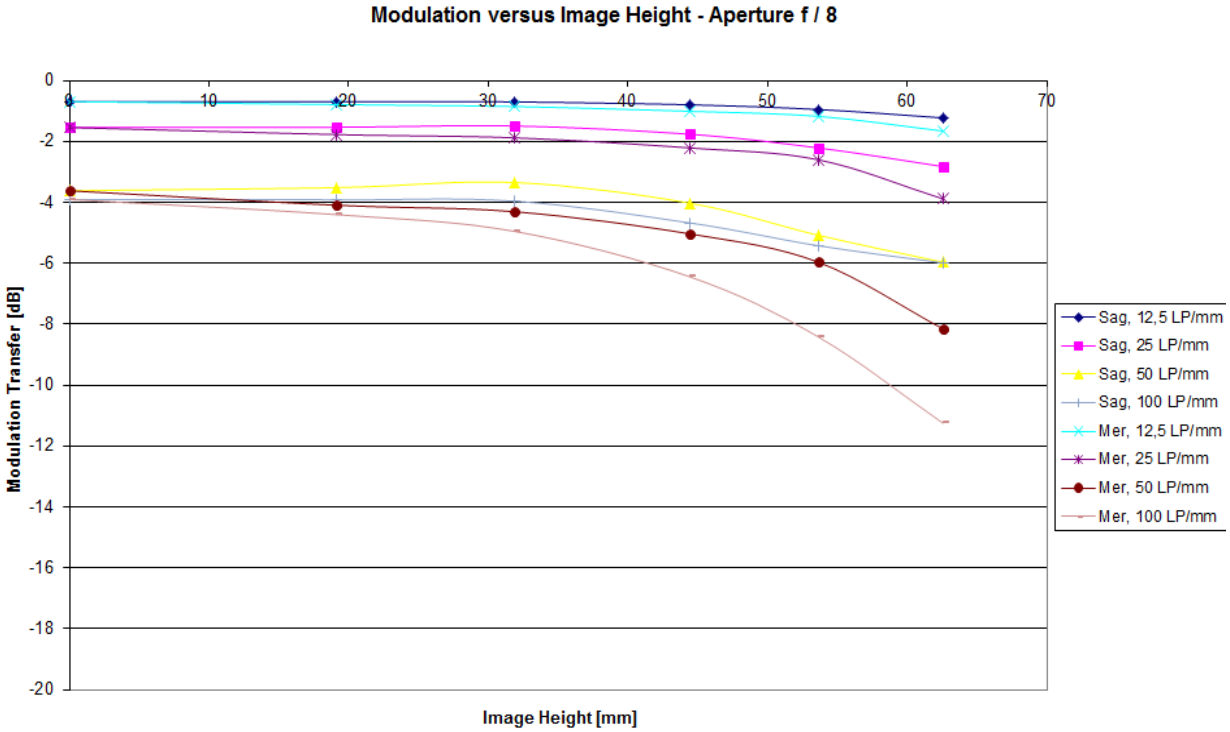
As the MTF is a function of the specific aperture size used, one set of curves is given for each aperture size.

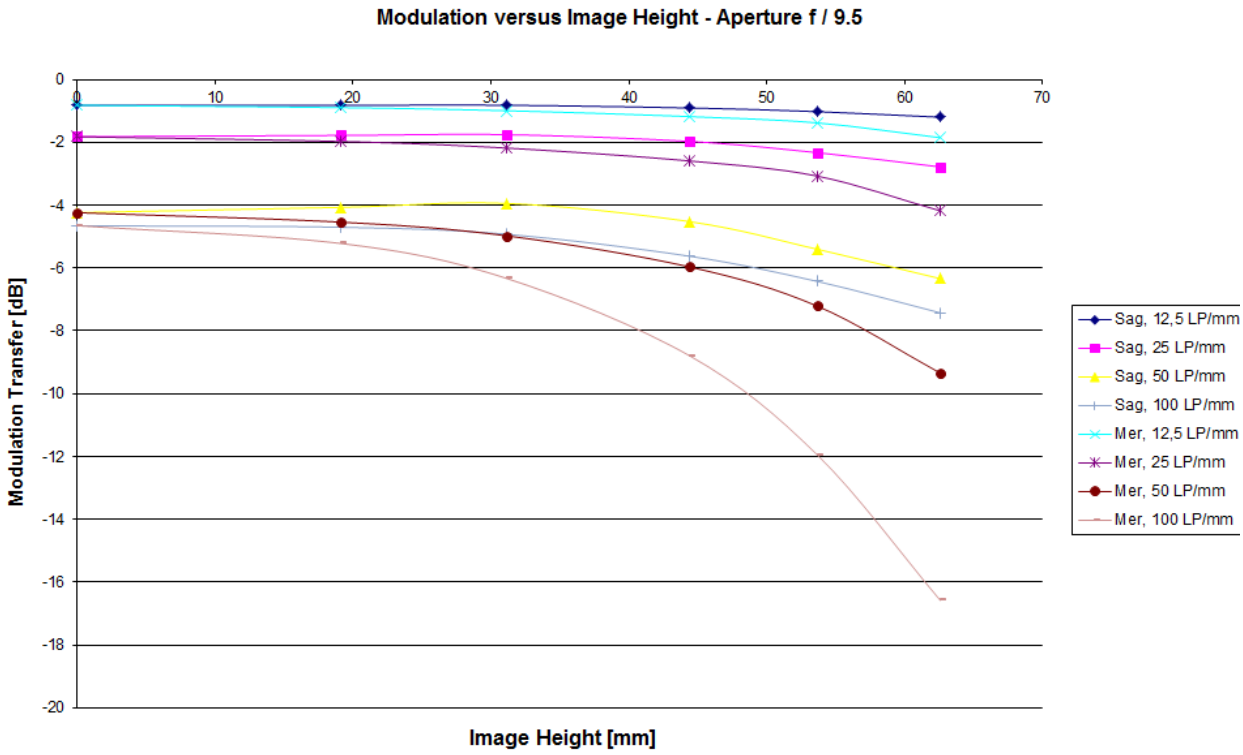
Lens types

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

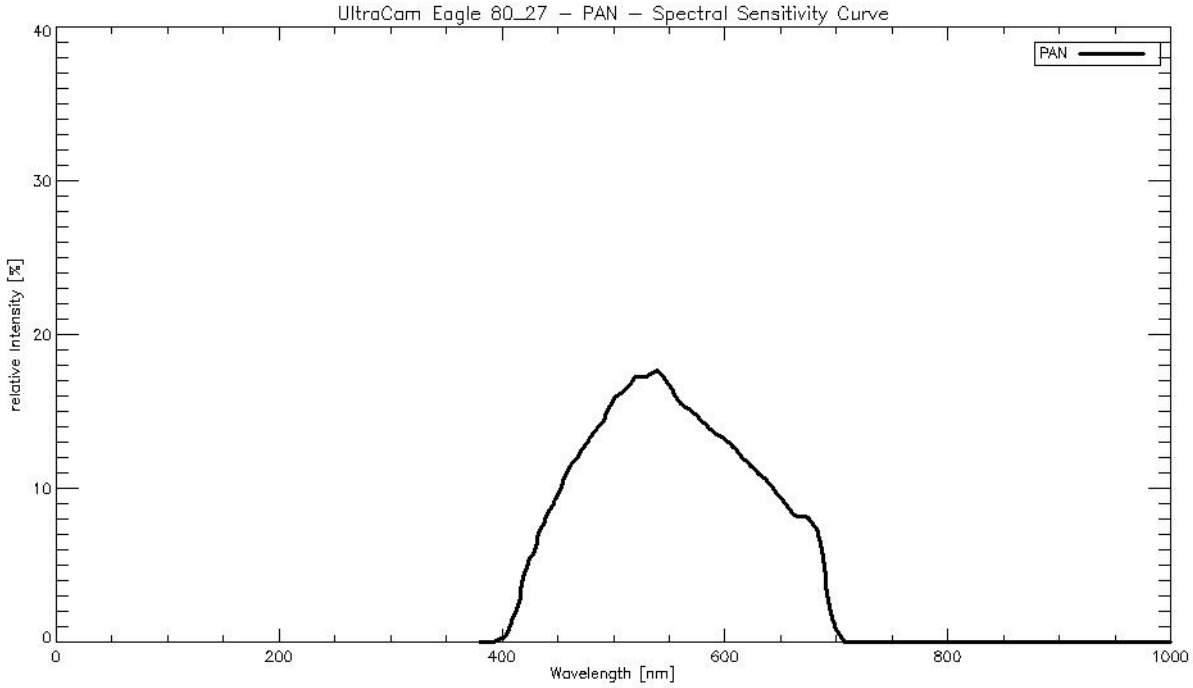

Modulation versus Image Height - Aperture f / 5.6
Modulation Transfer [dB]
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
0
10
20
30
40
50
60
70
Image Height [mm]
Sag, 12,5 LP/mm
Sag, 25 LP/mm
Sag, 50 LP/mm
Sag, 100 LP/mm
Mer, 12,5 LP/mm
Mer, 25 LP/mm
Mer, 50 LP/mm
Mer, 100 LP/mm

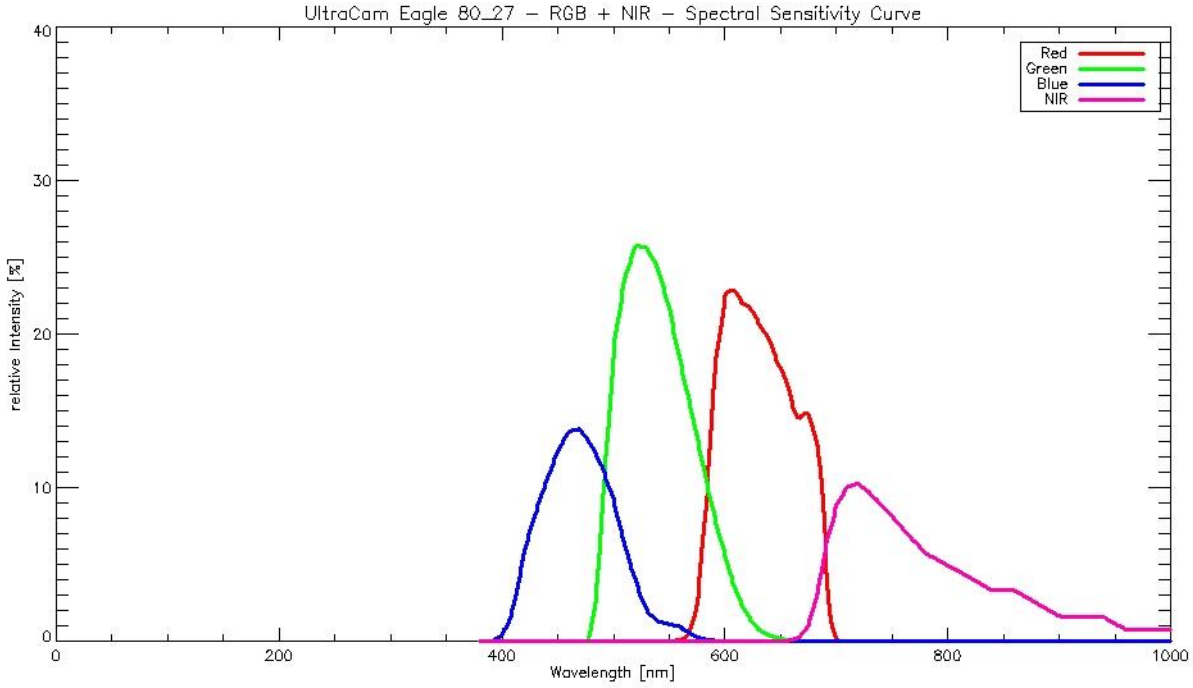

Modulation versus Image Height - Aperture f / 6.7
Modulation Transfer [dB]
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
0
10
20
30
40
50
60
70
Image Height [mm]
Sag, 12,5 LP/mm
Sag, 25 LP/mm
Sag, 50 LP/mm
Sag, 100 LP/mm
Mer, 12,5 LP/mm
Mer, 25 LP/mm
Mer, 50 LP/mm
Mer, 100 LP/mm


Modulation versus Image Height - Aperture f / 8
Modulation Transfer [dB]
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
0
10
20
30
40
50
60
70
Image Height [mm]
Sag, 12,5 LP/mm
Sag, 25 LP/mm
Sag, 50 LP/mm
Sag, 100 LP/mm
Mer, 12,5 LP/mm
Mer, 25 LP/mm
Mer, 50 LP/mm
Mer, 100 LP/mm


Modulation versus Image Height - Aperture f / 9.5
Modulation Transfer [dB]
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
0
10
20
30
40
50
60
70
Image Height [mm]
Sag, 12,5 LP/mm
Sag, 25 LP/mm
Sag, 50 LP/mm
Sag, 100 LP/mm
Mer, 12,5 LP/mm
Mer, 25 LP/mm
Mer, 50 LP/mm
Mer, 100 LP/mm

Spectral Sensitivity





ULTRACAM

Radiometric Calibration

Camera: **UltraCam Eagle**
Serial: **UC-E-1-50319383-f80**

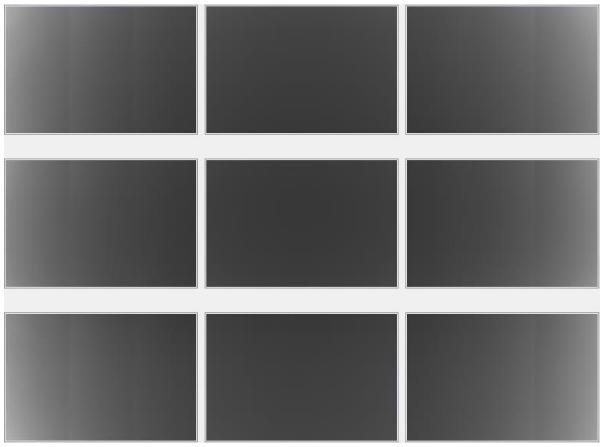
	PAN	R, G, NIR	B
Used Apertures	F5.6	F4.8	F4.8
	F6.5	F5.4	F4.8
	F8	F6.7	F4.8
	F9.5	F8	F5.6
	F11	F9.5	F6.7
	F13	F11	F8
	F16	F13	F9.5
	F22	F19	F13

Calibration Date: **May-30-2019**
Date of Report: **June-10-2019**
Camera Revision: **Rev04.00**
Version of Report: **V04**

Calibration of Vignetting for working Aperture F6.7

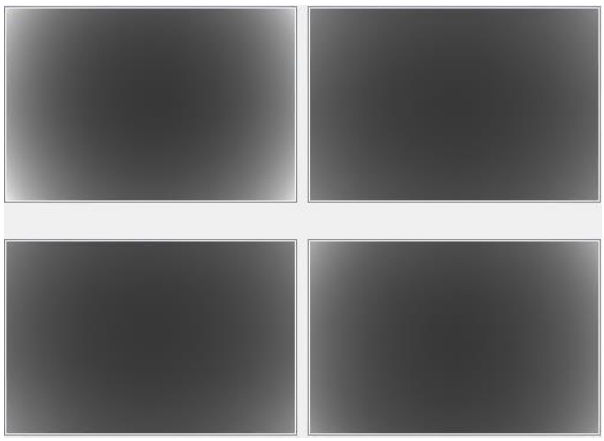
	PAN	R, G, NIR	B
Aperture	F6.5	F5.4	F4.8

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)

Dead Pixel Report:

Sensor number		
Anomaly type	X-Coordinate	Y-Coordinate

C00-00

PIXEL: 360/4225
PIXEL: 876/1046
PIXEL: 1318/3743
PIXEL: 1414/1364
PIXEL: 1469/ 193
PIXEL: 1469/ 194
PIXEL: 1469/1846
PIXEL: 1778/4416
PIXEL: 1803/4197
PIXEL: 2267/1263
PIXEL: 2360/1247
PIXEL: 2569/3386
PIXEL: 2617/ 666
PIXEL: 3028/ 452
PIXEL: 3794/2977
PIXEL: 3909/3509
PIXEL: 4141/3052
PIXEL: 4271/ 183
PIXEL: 4577/4094
PIXEL: 4692/1707
PIXEL: 4905/2138
PIXEL: 5879/3963
PIXEL: 6002/2188
PIXEL: 6039/3359
PIXEL: 6636/ 264
PIXEL: 6648/3138
PIXEL: 6918/3906
PIXEL: 4018/3892
PIXEL: 4018/3893
PIXEL: 4956/3705
PIXEL: 4957/3705
COLUMN: 6757/2039

C00-01

PIXEL: 700/3792
PIXEL: 870/1379
PIXEL: 937/ 737
PIXEL: 963/ 695
PIXEL: 2158/2615
PIXEL: 2182/3165

PIXEL: 2454/4191
PIXEL: 2672/2623
PIXEL: 2857/2368
PIXEL: 3027/3883
PIXEL: 3429/1782
PIXEL: 3955/ 779
PIXEL: 4102/3119
PIXEL: 4280/3677
PIXEL: 4330/4255
PIXEL: 4547/ 245
PIXEL: 4716/ 773
PIXEL: 4850/3853
PIXEL: 5392/3221
PIXEL: 5445/ 734
PIXEL: 5534/2029
PIXEL: 5597/ 724
PIXEL: 5753/ 688
PIXEL: 5824/2444
PIXEL: 6853/3486
PIXEL: 5670/1008
PIXEL: 6539/2603

C00-02

PIXEL: 1096/ 195
PIXEL: 1097/ 195
PIXEL: 464/ 134
PIXEL: 1015/3652
PIXEL: 1237/ 922
PIXEL: 1339/ 860
PIXEL: 1370/3993
PIXEL: 2076/3033
PIXEL: 2718/3355
PIXEL: 2881/2367
PIXEL: 3046/ 203
PIXEL: 4392/1373
PIXEL: 4837/3873
PIXEL: 4960/3855
PIXEL: 5805/1653
PIXEL: 6854/3868
PIXEL: 1095/ 196
PIXEL: 1096/ 196
PIXEL: 1098/ 195
PIXEL: 6329/ 602
PIXEL: 3961/4436
PIXEL: 3960/4437
PIXEL: 3962/4437
PIXEL: 3963/4438
PIXEL: 3961/4439
PIXEL: 3961/4438
PIXEL: 3963/4440

PIXEL: 3962/4439
PIXEL: 4191/4613
PIXEL: 4191/4613
PIXEL: 4190/4610
PIXEL: 4189/4613
PIXEL: 4189/4609
PIXEL: 4311/4610

C00-03

PIXEL: 173/ 58
PIXEL: 995/3185
PIXEL: 1276/2994
PIXEL: 1451/3374
PIXEL: 1703/1275
PIXEL: 1716/3137
PIXEL: 1829/1216
PIXEL: 1871/4184
PIXEL: 1945/ 588
PIXEL: 2651/1735
PIXEL: 2861/ 435
PIXEL: 3006/1597
PIXEL: 3272/1430
PIXEL: 3381/4139
PIXEL: 3777/ 684
PIXEL: 4006/2198
PIXEL: 4179/3674
PIXEL: 4299/ 748
PIXEL: 4557/1357
PIXEL: 4632/1246
PIXEL: 4683/ 52
PIXEL: 4816/2257
PIXEL: 4861/3954
PIXEL: 5429/1656
PIXEL: 5661/4548
PIXEL: 6636/4528
PIXEL: 6653/ 455
PIXEL: 6889/2074
PIXEL: 1657/3399

C01-00

PIXEL: 1453/4347
PIXEL: 1725/1636
PIXEL: 2854/2703
PIXEL: 2990/1726
PIXEL: 3231/1170
PIXEL: 4143/2465
PIXEL: 5229/2656
PIXEL: 5490/4411
PIXEL: 5928/ 495
PIXEL: 6112/4475

PIXEL: 6238/4205
PIXEL: 6383/3774
PIXEL: 6518/1941
PIXEL: 6688/1104
PIXEL: 63/4246
PIXEL: 77/ 146
PIXEL: 358/4249
PIXEL: 792/ 811
PIXEL: 829/ 806
PIXEL: 2292/1180
PIXEL: 2293/1179
PIXEL: 2293/1180
PIXEL: 3878/ 642
PIXEL: 3878/ 643
PIXEL: 5322/2473
PIXEL: 6855/4582
PIXEL: 6519/4486
PIXEL: 4548/4616
PIXEL: 4549/4616

C01-01

PIXEL: 479/2006
PIXEL: 792/ 601
PIXEL: 1766/1963
PIXEL: 2537/1141
PIXEL: 3629/2137
PIXEL: 3713/4325
PIXEL: 5464/3544
PIXEL: 5791/1388
PIXEL: 6331/ 902
PIXEL: 154/ 40
PIXEL: 247/4265
PIXEL: 247/4266
PIXEL: 248/4265
PIXEL: 248/4266
PIXEL: 1799/1331
PIXEL: 1800/1331
PIXEL: 1801/1331
PIXEL: 2413/1096
PIXEL: 291/4609
PIXEL: 291/4608

C02-00

PIXEL: 346/ 225
PIXEL: 1201/1244
PIXEL: 1485/3461
PIXEL: 2092/3077
PIXEL: 3219/4288
PIXEL: 4659/2662
PIXEL: 5041/2934
PIXEL: 5128/ 451

PIXEL: 5689/1731
PIXEL: 6067/3816
PIXEL: 6084/1568
PIXEL: 6113/2915
PIXEL: 1594/1549
PIXEL: 1595/1549
PIXEL: 3158/ 707
PIXEL: 3159/ 707
PIXEL: 1598/1550
PIXEL: 1597/1548
PIXEL: 1598/1548
PIXEL: 1596/1548
PIXEL: 1595/1548
PIXEL: 1594/1548

C02-01

PIXEL: 644/2776
PIXEL: 645/2776
PIXEL: 717/3360
PIXEL: 821/3458
PIXEL: 968/ 416
PIXEL: 1544/1256
PIXEL: 4718/ 977
PIXEL: 4824/3738
PIXEL: 4911/2187
PIXEL: 5158/3583
PIXEL: 5486/4357
PIXEL: 5898/2481
PIXEL: 6947/4622
PIXEL: 145/3292
PIXEL: 3620/4353
PIXEL: 4988/2042
PIXEL: 4988/2043
PIXEL: 6934/3171

C03-00

PIXEL: 61/4053
PIXEL: 476/2450
PIXEL: 558/3499
PIXEL: 1698/ 153
PIXEL: 2235/2906
PIXEL: 2749/ 943
PIXEL: 3091/3603
PIXEL: 3288/1366
PIXEL: 3509/4302
PIXEL: 3846/2312
PIXEL: 5373/4403
PIXEL: 5444/1321
PIXEL: 5515/1291
PIXEL: 6069/1165

PIXEL: 6138/2140
PIXEL: 6419/1235
PIXEL: 6664/ 980
PIXEL: 6547/4303
PIXEL: 6547/4304
PIXEL: 6548/4304
PIXEL: 6734/3883

C04-00

PIXEL: 1646/4386
PIXEL: 3624/2130
PIXEL: 4273/1124
PIXEL: 4642/1226
PIXEL: 28/ 84

C05-00

PIXEL: 254/4457
PIXEL: 256/1076
PIXEL: 481/ 463
PIXEL: 550/ 114
PIXEL: 1233/2016
PIXEL: 1557/1698
PIXEL: 1563/4208
PIXEL: 1667/ 854
PIXEL: 2812/4571
PIXEL: 3121/1933
PIXEL: 4199/3372
PIXEL: 4487/1901
PIXEL: 5070/2279
PIXEL: 6201/3796
PIXEL: 6245/4414
PIXEL: 6642/1054
PIXEL: 6847/1177
PIXEL: 2247/ 504
PIXEL: 6027/ 24

C06-00

PIXEL: 565/4024
PIXEL: 158/4353
PIXEL: 389/3129
PIXEL: 393/3556
PIXEL: 587/2061
PIXEL: 595/ 806
PIXEL: 631/3351
PIXEL: 868/ 992
PIXEL: 987/ 214
PIXEL: 1076/ 352
PIXEL: 1076/ 353
PIXEL: 1321/1114
PIXEL: 1673/3751

PIXEL: 1733/2097
PIXEL: 2092/ 648
PIXEL: 2566/4507
PIXEL: 3159/2210
PIXEL: 4189/1131
PIXEL: 4714/1525
PIXEL: 4827/2221
PIXEL: 4956/4000
PIXEL: 5237/4217
PIXEL: 565/4023
PIXEL: 662/ 15
PIXEL: 4951/4043
PIXEL: 4951/4044
PIXEL: 4952/4044
PIXEL: 6699/ 198

C07-00

PIXEL: 210/2353
PIXEL: 412/2719
PIXEL: 1557/4267
PIXEL: 1716/4217
PIXEL: 2193/2235
PIXEL: 2626/2609
PIXEL: 3339/ 692
PIXEL: 3960/3906
PIXEL: 4224/1435
PIXEL: 4471/ 476
PIXEL: 6193/2070
PIXEL: 6404/4473
PIXEL: 405/4430
PIXEL: 2138/4592
PIXEL: 1235/4616

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).

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-1-50319383-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 Date:	**May-30-2019**
Date of Report:	**June-10-2019**
Camera Revision:	**Rev04.00**
Version of Report:	**V04**

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.

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 15 42 95	11.43	11.80	12.41	12.80	13.17	13.38	13.46	13.96	+/- 0.2
C1 (Pan)	12 15 42 86	10.74	11.17	11.70	12.14	12.43	12.62	12.75	13.23	+/- 0.2
C2 (Pan)	12 15 43 00	11.67	12.17	12.81	13.18	13.46	13.87	14.04	14.55	+/- 0.2
C3 (Pan)	12 15 42 98	10.96	11.34	11.82	12.23	12.50	12.70	12.89	13.20	+/- 0.2
C4 (Red)	12 12 05 88	12.69	12.86	13.10	13.36	13.49	13.61	13.76	13.89	+/- 0.2
C5 (Green)	12 12 06 38	12.34	12.57	12.80	13.00	13.10	13.16	13.35	13.43	+/- 0.2
C6 (Blue)	12 12 06 30	13.05	13.09	13.09	13.43	13.67	13.86	14.07	14.57	+/- 0.2
C7 (NIR)	12 12 05 87	12.04	12.20	12.46	12.66	12.78	12.85	12.96	12.96	+/- 0.2

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Electronics and Sensor Calibration

Camera:	**UltraCam Eagle**
Serial:	**UC-E-1-50319383-f80**
Panchromatic Camera:	**9 * FTF7046-M Area CCD Sensor by DALSA**
Multispectral Camera:	**4 * FTF7046-M Area CCD Sensor by DALSA**
Calibration Date:	**May-30-2019**
Date of Report:	**June-10-2019**
Camera Revision:	**Rev04.00**
Version of Report:	**V04**

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.

Cone_Sensor	Sensor Type	Sensor Serial Number	VNS Voltage [V]
00_00	FTF7046-M	15 1276/034	24.40
00_01	FTF7046-M	15 1276/035	24.20
00_02	FTF7046-M	15 1276/033	25.00
00_03	FTF7046-M	15 1276/032	24.20
01_00	FTF7046-M	14 9219/032	23.60
01_01	FTF7046-M	14 8779/045	24.40
02_00	FTF7046-M	14 9895/006	24.20
02_01	FTF7046-M	15 1276/023	23.40
03_00	FTF7046-M	15 0541/009	23.60
04_00 (red)	FTF7046-M	15 0541/037	23.60
05_00 (green)	FTF7046-M	15 0541/033	23.60
06_00 (blue)	FTF7046-M	15 7349/048	24.40
07_00 (NIR)	FTF7046-M	15 0541/031	23.40

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.

Cone_Sensor	Sensor Type	Sensor Serial Number	Intensity Threshold [DN]
00_00	FTF7046-M	15 1276/034	13180
00_01	FTF7046-M	15 1276/035	13100
00_02	FTF7046-M	15 1276/033	12990
00_03	FTF7046-M	15 1276/032	13290
01_00	FTF7046-M	14 9219/032	13630
01_01	FTF7046-M	14 8779/045	13820
02_00	FTF7046-M	14 9895/006	13830
02_01	FTF7046-M	15 1276/023	14000
03_00	FTF7046-M	15 0541/009	13330
04_00 (red)	FTF7046-M	15 0541/037	13800
05_00 (green)	FTF7046-M	15 0541/033	13740
06_00 (blue)	FTF7046-M	15 7349/048	13490
07_00 (NIR)	FTF7046-M	15 0541/031	13180

ULTRACAM

Summary

Camera:	**UltraCam Eagle**
Serial:	**UC-E-1-50319383-f80**
Calibration Date:	**May-30-2019**
Date of Report:	**June-10-2019**
Camera Revision:	**Rev04.00**
Version of Report:	**V04**

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.

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