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 M3**
Serial:	**431S92908X210339-f100**
Panchromatic Camera:	**ck = 100.500 mm**
Multispectral Camera:	**ck = 100.500 mm**
PPA Information:	**X: -0.120 mm**
	Y: 0.000 mm

Panchromatic Camera

Large Format Panchromatic Output Image

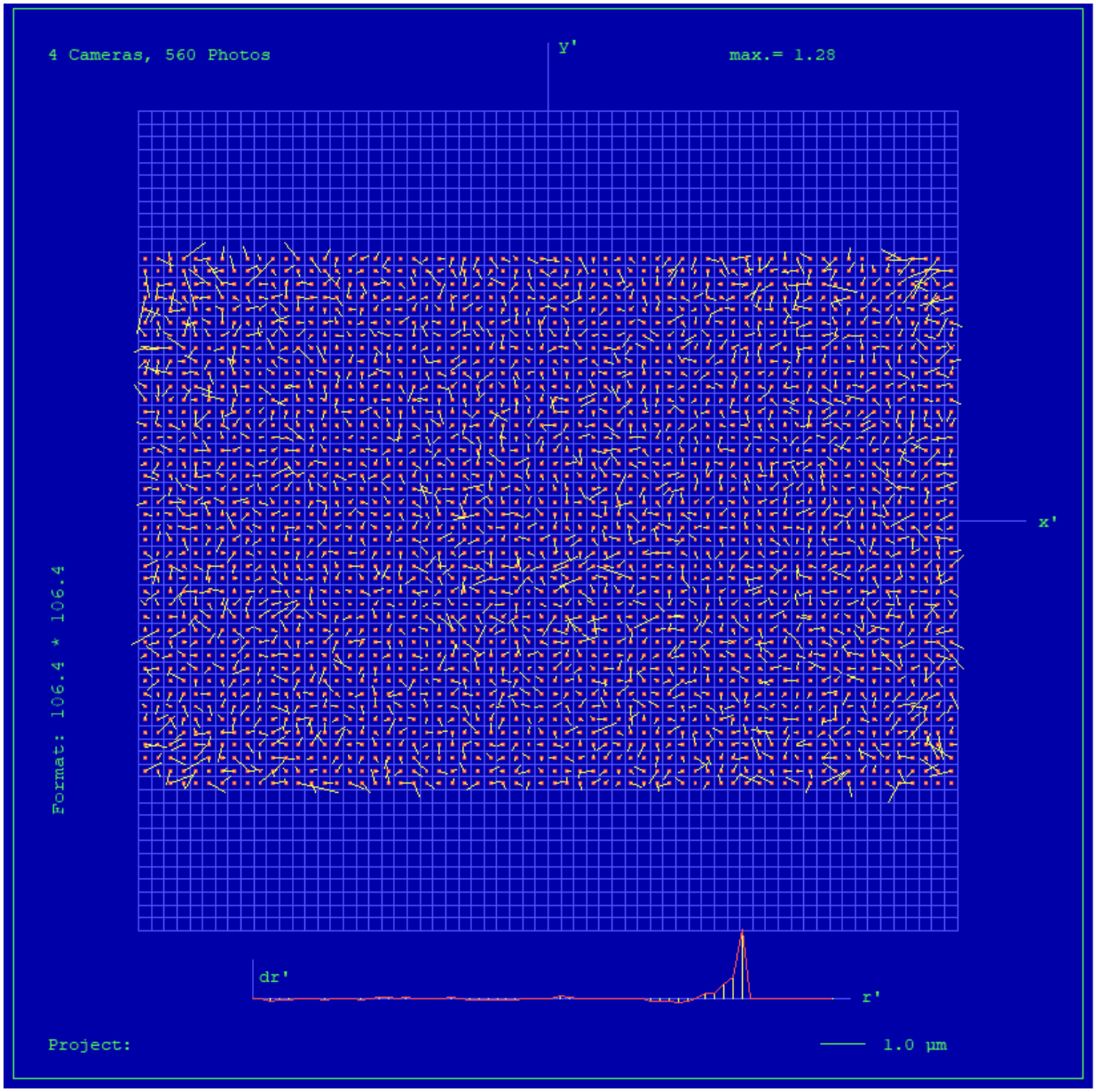
Image Format	long track cross track	68.016mm 105.840mm	17004pixel 26460pixel
Image Extent		(-34.008, -52.920)mm	(34.008, 52.920)mm
Pixel Size		4.000µm*4.000µm	
Focal Length	ck	100.500mm	± 0.002mm
Principal Point (Level 2)	X_ppa	-0.120mm	± 0.002mm
	Y_ppa	0.000mm	± 0.002mm
Lens Distortion	Remaining Distortion less than 0.002mm		

Multispectral Camera

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

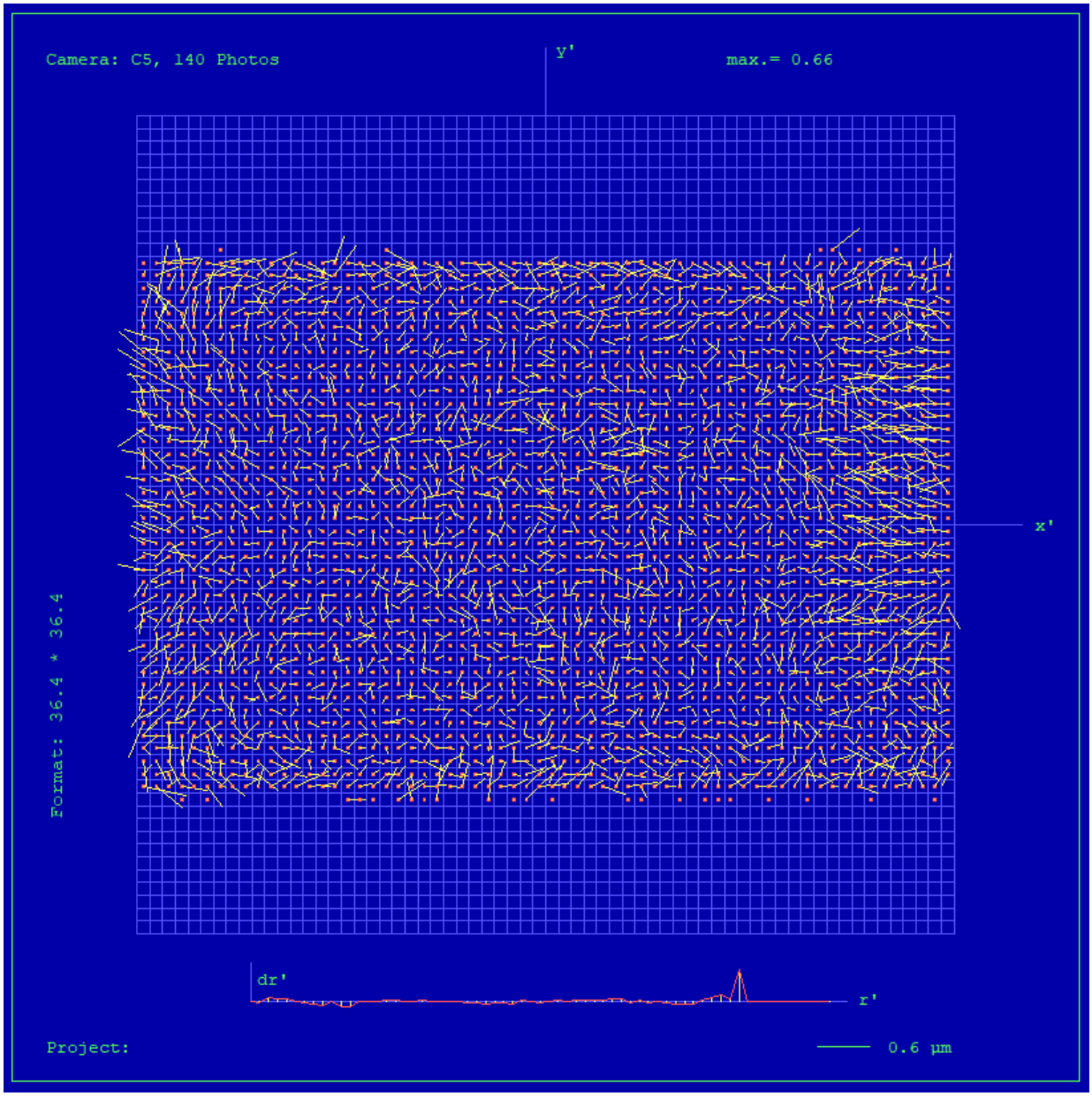
Image Format	long track cross track	68.016mm 105.840mm	5668pixel 8820pixel
Image Extent		(-34.008, -52.920)mm	(34.008, 52.920)mm
Pixel Size		12.000µm*12.000µm	
Focal Length	ck	100.500mm	± 0.002mm
Principal Point (Level 2)	X_ppa	-0.120mm	± 0.002mm
	Y_ppa	0.000mm	± 0.002mm
Lens Distortion	Remaining Distortion less than 0.002mm		

Full Panchromatic Image, Residual Error Diagram



Residual Error (RMS): **0.52 µm**

Green Cone (Cone 5), Residual Error Diagram



Residual Error (RMS): **0.43 µm**

Explanations

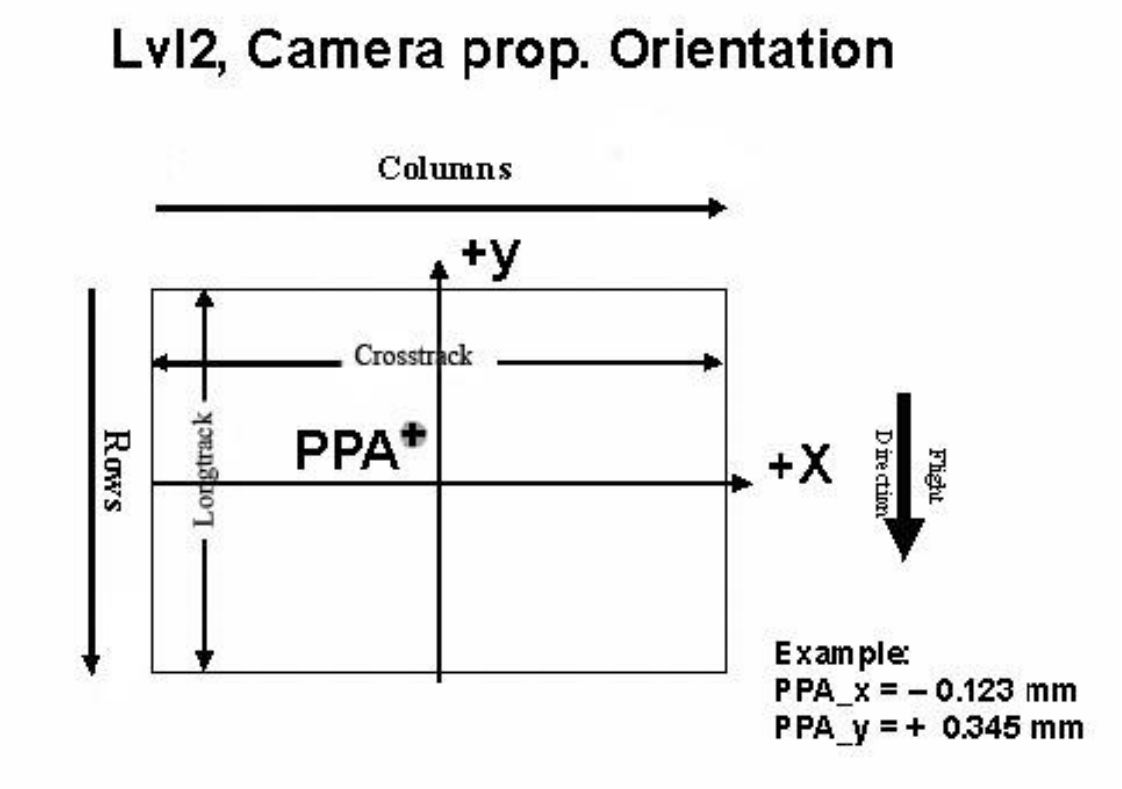
Calibration Method:

The geometric calibration is based on a set of 140 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

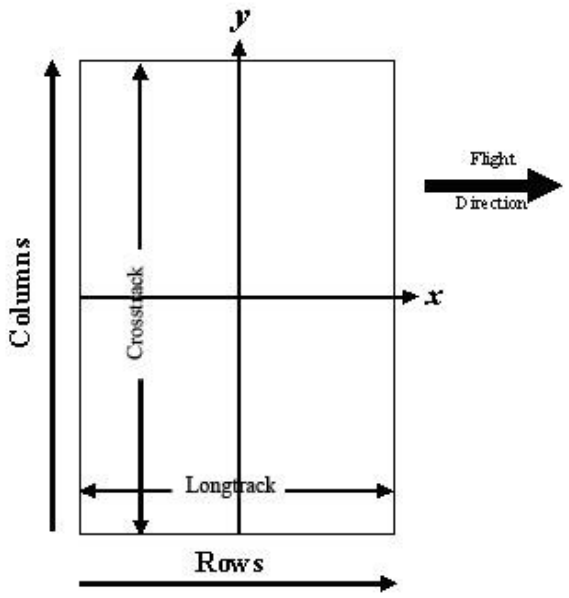
Determination of the image parameters by Least Squares Adjustment.
Software used for the adjustment: BINGO (GIP Eng. Aalen, Germany)

Level 2 Image Coordinate System:

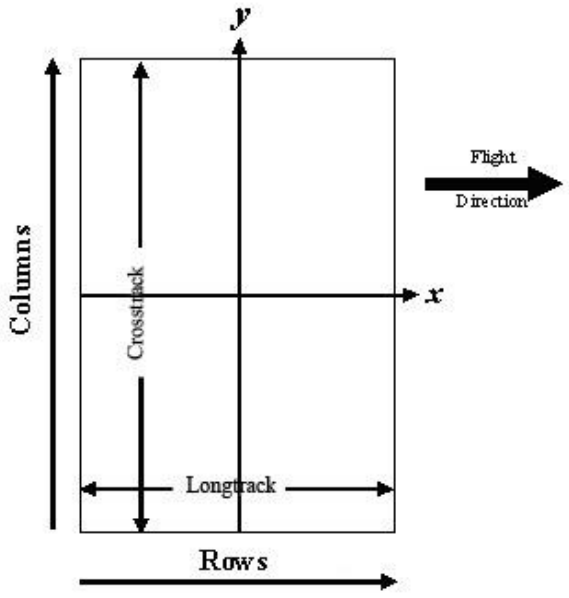


The image coordinate system of the Level 2 images is shown in the above figure. The basic image format and coordinate of the principal point in the level 2 image is given on page 4 of this report. The above figure shows the position of an example principal point at the coordinate (-0.123 / 0.345).

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



Panchromatic Image Format



Multispectral Image Format

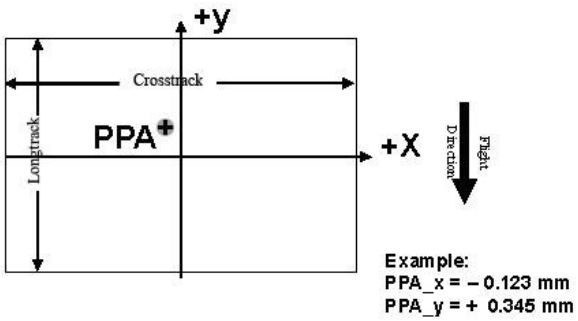
Position of Principal Point in Level 3 Image

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	-	-0.120	0.000
Level 3	0	-0.120	0.000
Level 3	90	0.000	0.120
Level 3	180	0.120	0.000
Level 3	270	0.000	-0.120

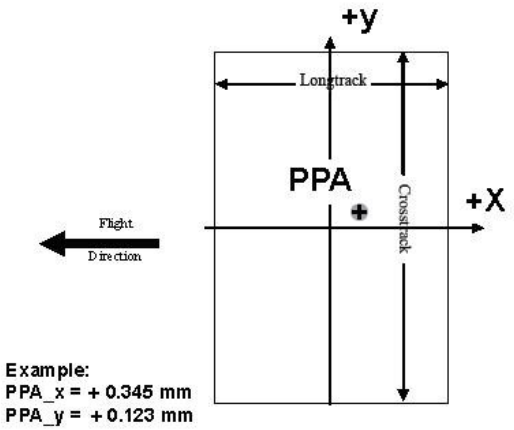
The coordinates in the figure below are only example values to illustrate the effect of image rotation on the principal point position, and do **not** correspond to the camera described in this report.

Lvl3, Rotation 0 deg clockwise



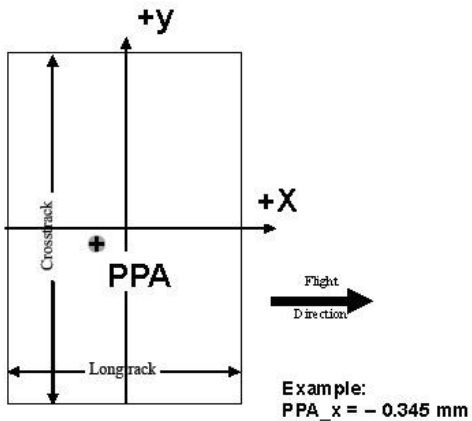
Example:
PPA_x = – 0.123 mm
PPA_y = + 0.345 mm

Lvl3, Rotation 90 deg clockwise



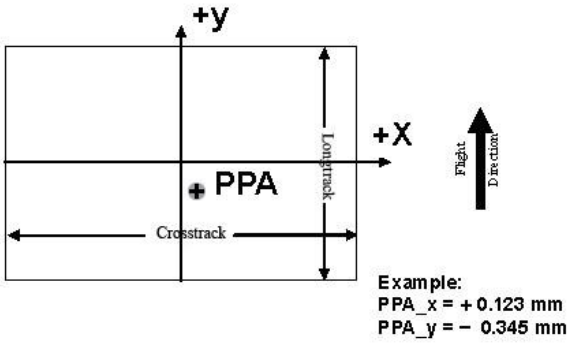
Example:
PPA_x = + 0.345 mm
PPA_y = + 0.123 mm

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

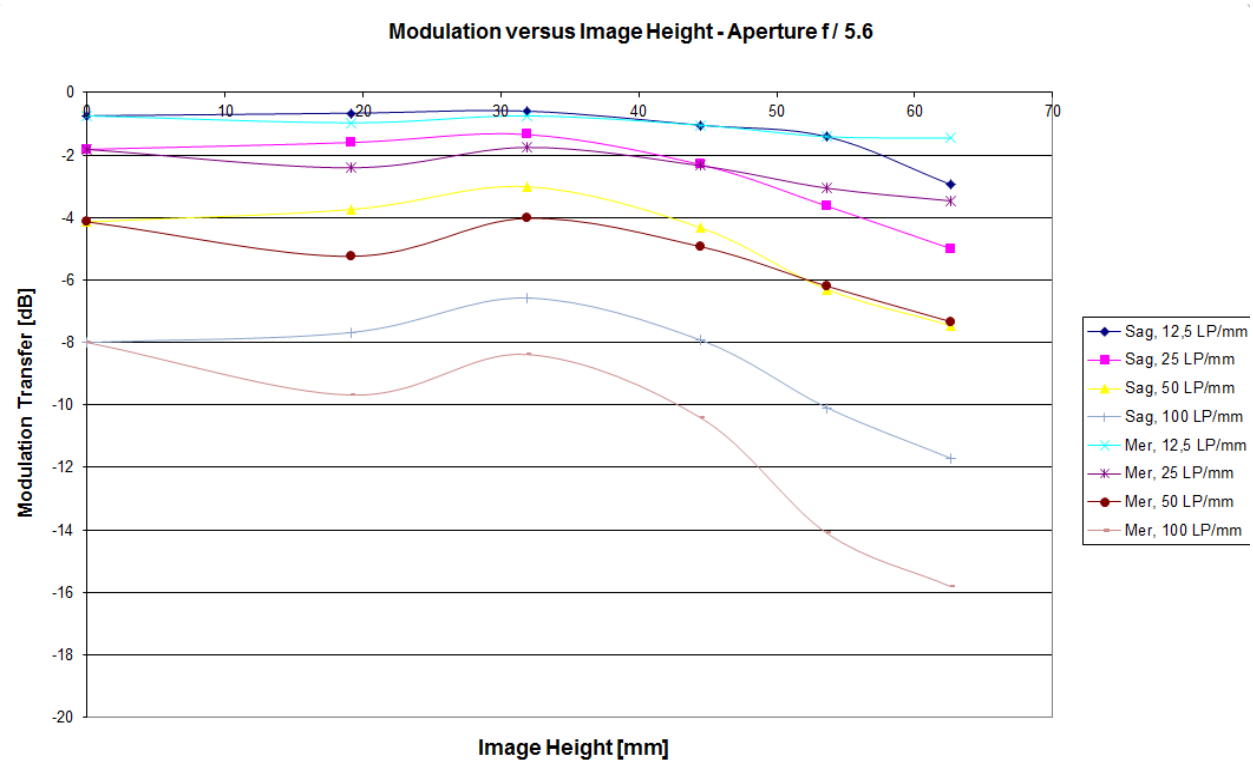
The following curves show the development of the modulation transfer function across different image heights of the panchromatic cones.
Please note that these values have been calculated and can vary up to 10% with optics from production (especially at high LP's).

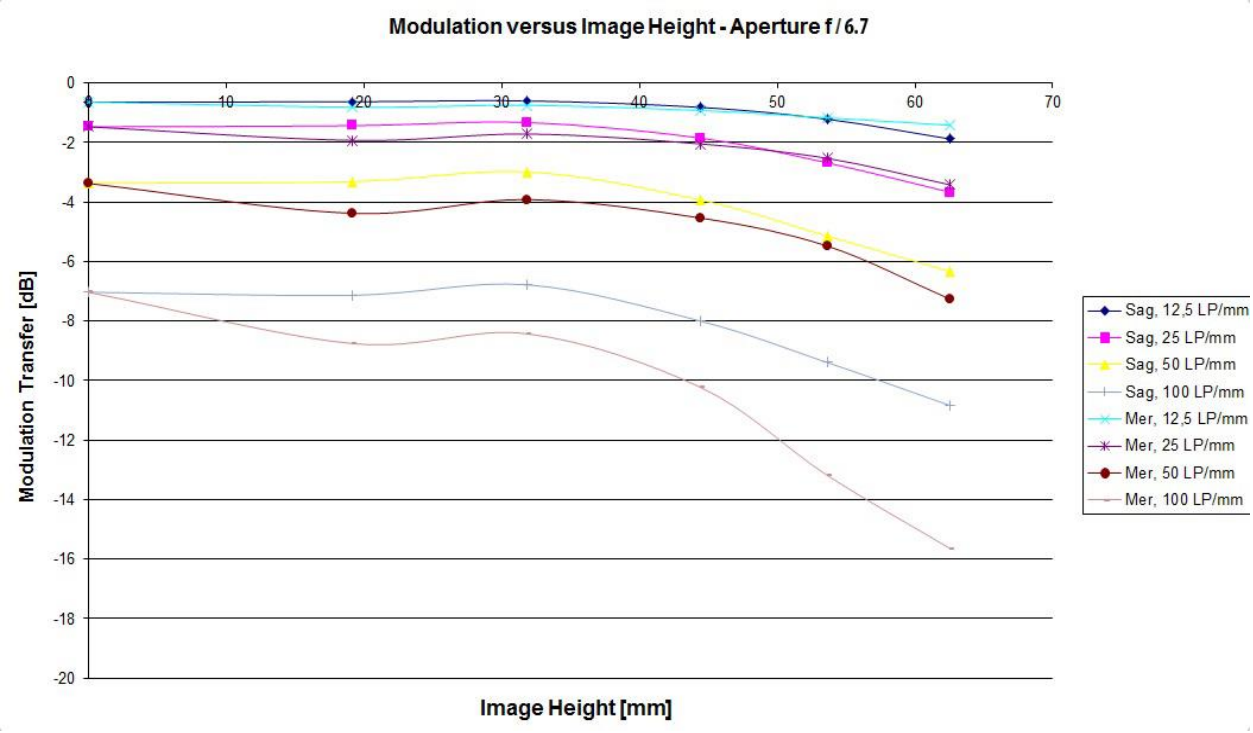
The curves are given for the meridonial (tangential) and sagital (radial) component of signals at frequencies of 12.5, 25, 50 and 100 line pairs per millimeter.

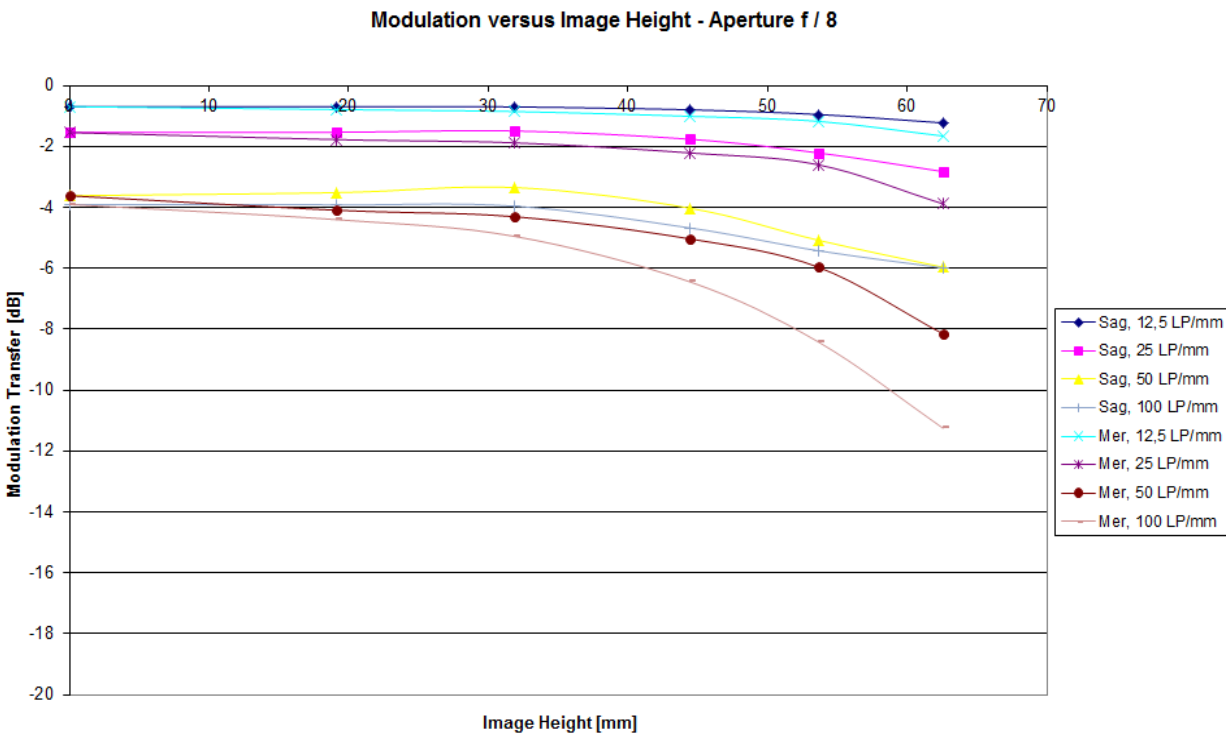
As the MTF is a function of the specific aperture size used, one set of curves is given for each aperture size.

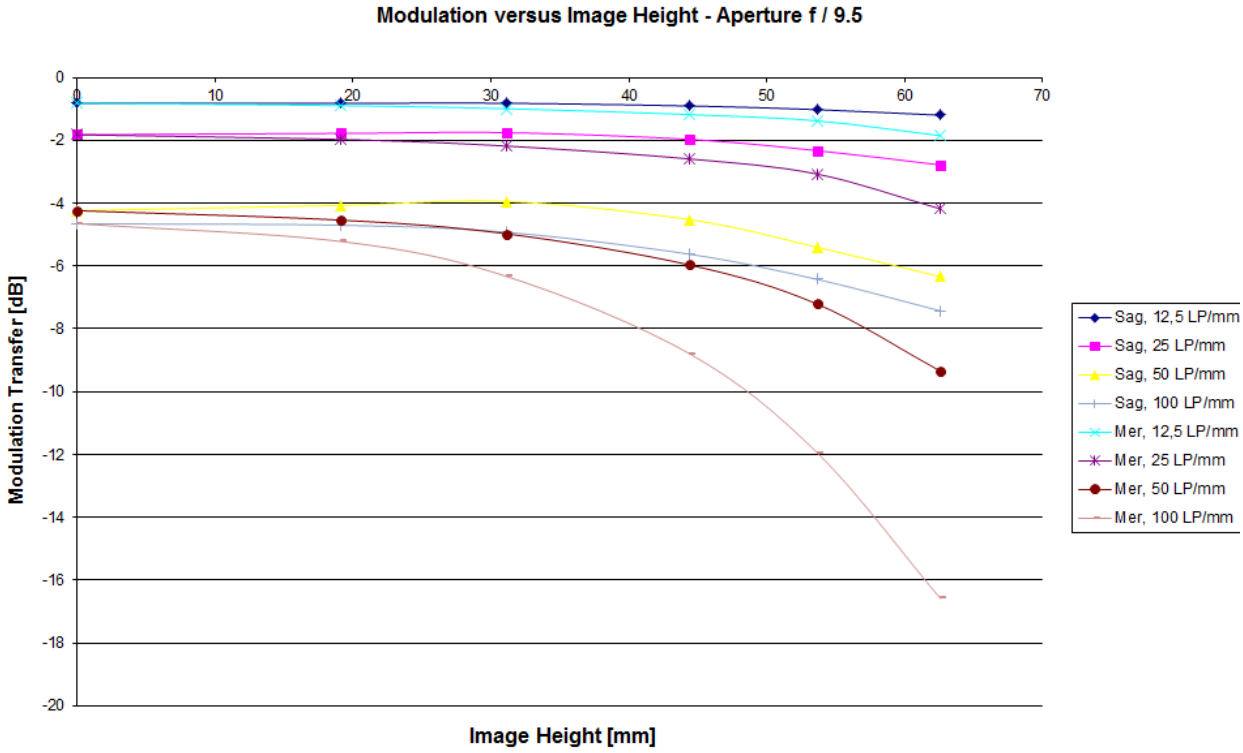
Lens types

Cone	Lens
C0 (PAN)	Qioptic Vexcel HR Digaron 1:5,6/100mm, Qioptic GmbH, Germany
C1 (PAN)	Qioptic Vexcel HR Digaron 1:5,6/100mm, Qioptic GmbH, Germany
C2 (PAN)	Qioptic Vexcel HR Digaron 1:5,6/100mm, Qioptic GmbH, Germany
C3 (PAN)	Qioptic Vexcel HR Digaron 1:5,6/100mm, Qioptic GmbH, Germany
C4 (RED)	Qioptic Vexcel HR Digaron 1:4/33mm, Qioptic GmbH, Germany
C5 (GREEN)	Qioptic Vexcel HR Digaron 1:4/33mm, Qioptic GmbH, Germany
C6 (BLUE)	Qioptic Vexcel HR Digaron 1:4/33mm, Qioptic GmbH, Germany
C7 (NIR)	Qioptic Vexcel HR Digaron 1:4/33mm, Qioptic GmbH, Germany

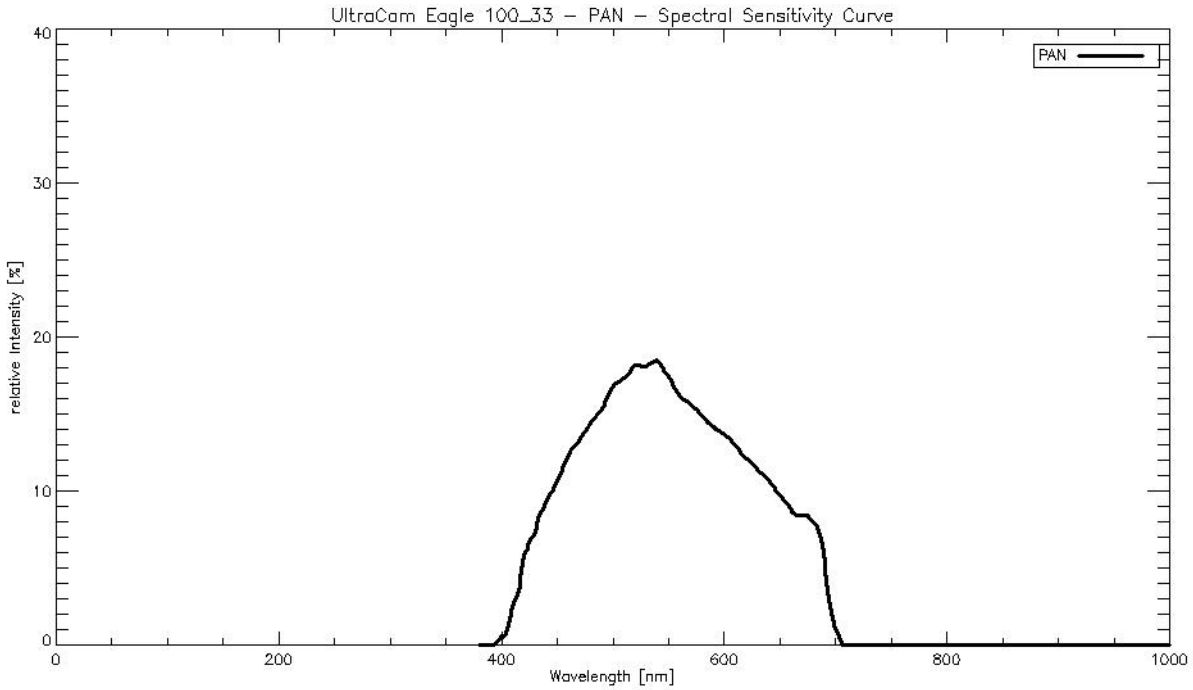

Modulation versus Image Height - Aperture f / 5.6
Modulation Transfer [dB]
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
0
10
20
30
40
50
60
70
Image Height [mm]
Sag, 12,5 LP/mm
Sag, 25 LP/mm
Sag, 50 LP/mm
Sag, 100 LP/mm
Mer, 12,5 LP/mm
Mer, 25 LP/mm
Mer, 50 LP/mm
Mer, 100 LP/mm

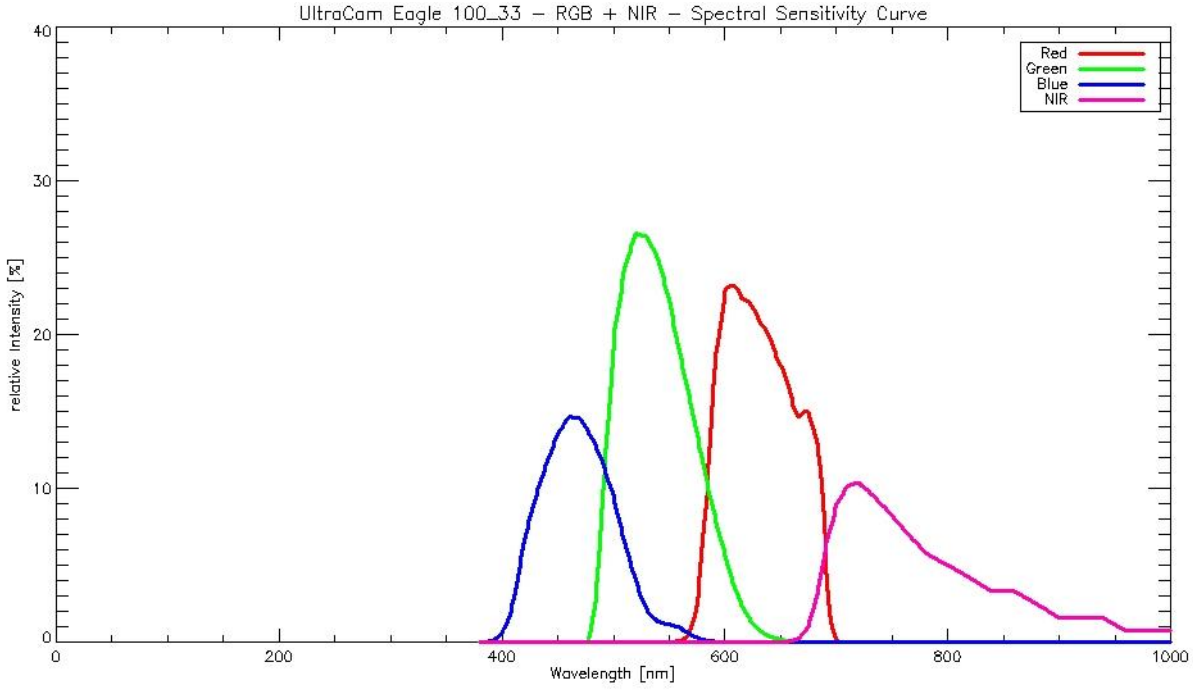

Modulation versus Image Height - Aperture f / 6.7
Modulation Transfer [dB]
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
0
10
20
30
40
50
60
70
Image Height [mm]
Sag, 12,5 LP/mm
Sag, 25 LP/mm
Sag, 50 LP/mm
Sag, 100 LP/mm
Mer, 12,5 LP/mm
Mer, 25 LP/mm
Mer, 50 LP/mm
Mer, 100 LP/mm


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





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Radiometric Calibration

Camera: **UltraCam Eagle M3**
Serial: **431S92908X210339-f100**

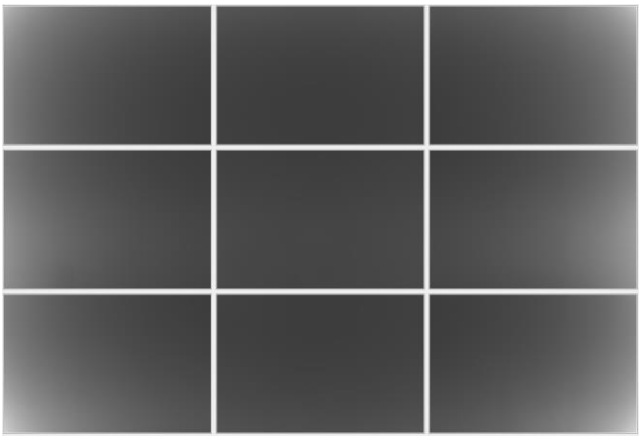
	PAN	R, G, NIR	B
Used Apertures	F5.6	F4.8	F4.8
	F6.7	F5.6	F4.8
	F8	F6.7	F4.8
	F9.5	F8	F5.6
	F11	F9.5	F6.7
	F13	F11	F8
	F16	F13	F9.5
	F22	F19	F13

Dead Pixel Report: see Appendix I

Calibration of Vignetting for working Aperture F6.7

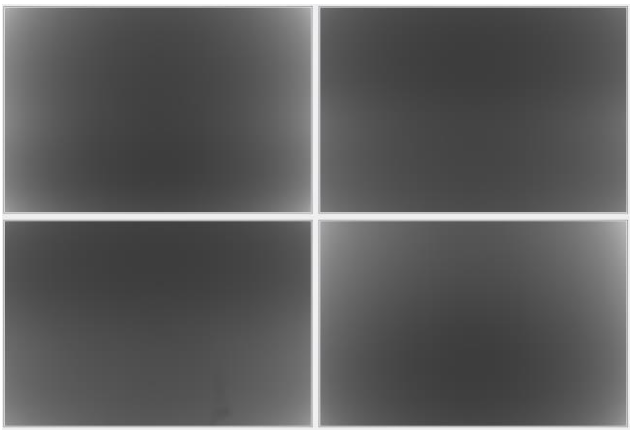
	PAN	R, G, NIR	B
Aperture	F6.7	F5.6	F4.8

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 M3**
Serial:	**431S92908X210339-f100**
Panchromatic Camera:	**4 * Prontor Magnetic 0 HS** **Prontor-Werk Alfred Gauthier GmbH, Germany**
Multispectral Camera:	**4 * Prontor Magnetic 0 HS** **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 51 53 70	6.37	6.55	6.80	7.07	7.29	7.40	7.45	7.91	+/- 0.2
C1 (Pan)	12 52 75 26	6.57	6.73	7.04	7.30	7.52	7.65	7.80	8.18	+/- 0.2
C2 (Pan)	12 51 53 63	6.22	6.48	6.78	7.02	7.23	7.35	7.45	7.84	+/- 0.2
C3 (Pan)	12 52 75 31	6.31	6.49	6.81	7.06	7.19	7.28	7.54	7.80	+/- 0.2
C4 (Red)	12 51 84 33	7.31	7.43	7.56	7.78	7.82	7.91	8.18	8.33	+/- 0.2
C5 (Green)	12 51 84 27	7.22	7.34	7.51	7.69	7.74	7.85	7.99	8.25	+/- 0.2
C6 (Blue)	12 51 84 23	7.18	7.23	7.23	7.39	7.59	7.72	7.82	8.27	+/- 0.2
C7 (NIR)	12 51 54 06	7.18	7.28	7.38	7.67	7.89	8.03	8.25	8.73	+/- 0.2

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Electronics and Sensor Calibration

Camera:	**UltraCam Eagle M3**
Serial:	**431S92908X210339-f100**
Panchromatic Camera:	**9 * FTF9060-M Area CCD Sensor by DALSA**
Multispectral Camera:	**4 * FTF9060-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]	VOG Voltage [V]
00_00	FTF9060-M	20 0548/042	22.20	6.82
00_01	FTF9060-M	20 5220/014	21.40	6.02
00_02	FTF9060-M	20 0548/043	22.00	6.83
00_03	FTF9060-M	20 0548/072	22.00	6.96
01_00	FTF9060-M	20 0548/058	22.00	6.66
01_01	FTF9060-M	20 5220/018	21.40	5.93
02_00	FTF9060-M	20 5220/019	21.40	6.19
02_01	FTF9060-M	20 0548/071	21.40	6.25
03_00	FTF9060-M	20 0548/079	22.20	6.31
04_00 (red)	FTF9060-M	20 5220/022	21.60	6.05
05_00 (green)	FTF9060-M	20 5220/020	21.60	6.70
06_00 (blue)	FTF9060-M	20 0548/044	21.60	6.09
07_00 (NIR)	FTF9060-M	20 0548/059	21.80	6.66

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]	
			Tap 1	Tap2
00_00	FTF9060-M	20 0548/042	13360	12890
00_01	FTF9060-M	20 5220/014	13430	12880
00_02	FTF9060-M	20 0548/043	13440	12560
00_03	FTF9060-M	20 0548/072	13410	11900
01_00	FTF9060-M	20 0548/058	13540	12490
01_01	FTF9060-M	20 5220/018	13700	13000
02_00	FTF9060-M	20 5220/019	13770	12870
02_01	FTF9060-M	20 0548/071	13800	12790
03_00	FTF9060-M	20 0548/079	13760	13030
04_00 (red)	FTF9060-M	20 5220/022	13520	12770
05_00 (green)	FTF9060-M	20 5220/020	13810	12870
06_00 (blue)	FTF9060-M	20 0548/044	14080	13130
07_00 (NIR)	FTF9060-M	20 0548/059	13570	12700

ULTRACAM

Summary

Camera:	**UltraCam Eagle M3**
Serial:	**431S92908X210339-f100**
Laboratory Calibration Date:	**Aug-18-2020**
Camera Revision:	**Rev01.00**
Date of Report:	**Sept-03-2020**
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: 817/5025
PIXEL: 1097/4331
PIXEL: 1364/ 851
PIXEL: 1431/ 319
PIXEL: 1591/3206
PIXEL: 1670/5097
PIXEL: 1822/5173
PIXEL: 2112/2277
PIXEL: 2122/5533
PIXEL: 2329/3920
PIXEL: 2532/3958
PIXEL: 2592/5991
PIXEL: 2758/ 469
PIXEL: 2799/5566
PIXEL: 3110/2337
PIXEL: 3309/3790
PIXEL: 3580/5607
PIXEL: 3740/4741
PIXEL: 3835/3513
PIXEL: 4476/5678
PIXEL: 4536/1569
PIXEL: 4540/1977
PIXEL: 4871/5023
PIXEL: 4890/4134
PIXEL: 4958/1493
PIXEL: 4962/4035
PIXEL: 4962/4087
PIXEL: 5065/3197
PIXEL: 5140/ 99
PIXEL: 5297/3610
PIXEL: 5494/4903
PIXEL: 5971/4413
PIXEL: 6005/4361
PIXEL: 6055/ 982
PIXEL: 6094/4600

PIXEL: 6160/3090
PIXEL: 6161/3092
PIXEL: 6161/3093
PIXEL: 6161/3096
PIXEL: 6530/5313
PIXEL: 6963/5754
PIXEL: 6996/ 589
PIXEL: 7036/5205
PIXEL: 7231/2781
PIXEL: 7231/5456
PIXEL: 7231/5763
PIXEL: 7231/5770
PIXEL: 7231/5988
PIXEL: 7267/5433
PIXEL: 7406/4875
PIXEL: 7418/2968
PIXEL: 7975/1210
PIXEL: 8039/4715
PIXEL: 8114/4725
PIXEL: 8171/ 357
PIXEL: 8273/4343
PIXEL: 8439/2810
PIXEL: 8725/5375
PIXEL: 9036/5867
PIXEL: 139/5407
PIXEL: 1387/5504
PIXEL: 3835/5406
PIXEL: 3836/5405
PIXEL: 6652/2431
PIXEL: 8568/2104

C00-01

PIXEL: 262/4627
PIXEL: 307/4380
PIXEL: 623/4611
PIXEL: 698/ 690
PIXEL: 836/5961
PIXEL: 1004/2186
PIXEL: 1571/5390
PIXEL: 2348/2424
PIXEL: 2831/2662
PIXEL: 2878/2886
PIXEL: 3165/2609
PIXEL: 3239/3106
PIXEL: 3250/2669
PIXEL: 3439/4568
PIXEL: 3640/1525

PIXEL: 3670/ 229
PIXEL: 4161/3935
PIXEL: 4484/3034
PIXEL: 4500/1555
PIXEL: 4641/5553
PIXEL: 5149/3415
PIXEL: 7416/4822
PIXEL: 8094/3340
PIXEL: 8178/ 759
PIXEL: 8493/2368
PIXEL: 8638/2637
PIXEL: 8757/3809
PIXEL: 8807/ 453
PIXEL: 504/5014
PIXEL: 5147/5937
PIXEL: 6758/3524
PIXEL: 8507/2334
PIXEL: 8508/2335
PIXEL: 8844/5508

C00-02

PIXEL: 106/3316
PIXEL: 192/4379
PIXEL: 1586/5812
PIXEL: 1983/3846
PIXEL: 2153/2926
PIXEL: 2489/3895
PIXEL: 2646/ 609
PIXEL: 2854/2797
PIXEL: 2928/2897
PIXEL: 3326/4177
PIXEL: 3586/2187
PIXEL: 3739/5116
PIXEL: 3863/5736
PIXEL: 4065/1184
PIXEL: 4255/ 487
PIXEL: 4387/3541
PIXEL: 4667/5681
PIXEL: 4829/3184
PIXEL: 5131/1237
PIXEL: 5145/2553
PIXEL: 5183/2389
PIXEL: 5237/4305
PIXEL: 5247/ 708
PIXEL: 5753/3118
PIXEL: 5766/1732
PIXEL: 6061/5967

PIXEL: 6081/4921
PIXEL: 6186/4000
PIXEL: 6652/5050
PIXEL: 6866/5556
PIXEL: 6974/ 110
PIXEL: 7284/3687
PIXEL: 7466/4754
PIXEL: 7481/ 709
PIXEL: 7669/5598
PIXEL: 7688/1335
PIXEL: 7805/2694
PIXEL: 7876/1757
PIXEL: 7938/ 464
PIXEL: 8237/5695
PIXEL: 8237/5923
PIXEL: 8272/5351
PIXEL: 8423/3517
PIXEL: 8990/3940
PIXEL: 1633/2854
PIXEL: 6468/4327

C00-03

PIXEL: 270/5737
PIXEL: 270/5738
PIXEL: 278/2457
PIXEL: 298/2169
PIXEL: 618/4032
PIXEL: 903/ 41
PIXEL: 1472/2272
PIXEL: 1594/3331
PIXEL: 1654/4784
PIXEL: 1719/ 820
PIXEL: 1748/5817
PIXEL: 1801/3209
PIXEL: 1972/3157
PIXEL: 2140/4241
PIXEL: 3109/3457
PIXEL: 3263/4448
PIXEL: 3279/ 563
PIXEL: 3933/ 349
PIXEL: 4009/5033
PIXEL: 4127/2034
PIXEL: 4166/5883
PIXEL: 4577/4799
PIXEL: 4733/5741
PIXEL: 4976/4511
PIXEL: 5244/1780

PIXEL: 6316/1040
PIXEL: 6499/2494
PIXEL: 6773/2770
PIXEL: 7083/ 725
PIXEL: 7268/2286
PIXEL: 7459/2528
PIXEL: 7684/3654
PIXEL: 7838/4495
PIXEL: 8048/5681
PIXEL: 8066/5234
PIXEL: 8263/3941
PIXEL: 8331/1646
PIXEL: 8436/1863
PIXEL: 8573/3236
PIXEL: 8692/4242
PIXEL: 8845/1615
PIXEL: 926/1570
PIXEL: 927/1570
PIXEL: 4026/ 675
PIXEL: 6407/ 743
PIXEL: 7076/4084
PIXEL: 7227/1080

C01-00

PIXEL: 269/2973
PIXEL: 534/4574
PIXEL: 754/6003
PIXEL: 1090/3179
PIXEL: 1936/ 133
PIXEL: 1969/5947
PIXEL: 2074/5385
PIXEL: 2259/1468
PIXEL: 3233/ 511
PIXEL: 3367/5904
PIXEL: 3378/4604
PIXEL: 3554/5729
PIXEL: 3984/4211
PIXEL: 4313/6005
PIXEL: 4327/3616
PIXEL: 4524/5303
PIXEL: 5006/3951
PIXEL: 5136/1307
PIXEL: 5338/1569
PIXEL: 5653/5091
PIXEL: 5662/4244
PIXEL: 6150/4779
PIXEL: 6327/5242

PIXEL: 6607/3454
PIXEL: 6767/1731
PIXEL: 7088/4296
PIXEL: 7263/4369
PIXEL: 7704/4874
PIXEL: 7967/5340
PIXEL: 8026/4685
PIXEL: 8715/4845
PIXEL: 8863/2387
PIXEL: 6292/3085
PIXEL: 6293/3085

C01-01

PIXEL: 264/6007
PIXEL: 404/3443
PIXEL: 1044/3647
PIXEL: 1222/5355
PIXEL: 1238/4344
PIXEL: 1278/5105
PIXEL: 1438/ 510
PIXEL: 2315/ 787
PIXEL: 2563/2585
PIXEL: 3325/3899
PIXEL: 3378/2331
PIXEL: 3569/ 738
PIXEL: 3813/4888
PIXEL: 4496/5800
PIXEL: 5042/1184
PIXEL: 5293/2028
PIXEL: 5322/4486
PIXEL: 5595/2488
PIXEL: 5939/5412
PIXEL: 7156/4265
PIXEL: 7199/1486
PIXEL: 7639/4954
PIXEL: 7848/5639
PIXEL: 8104/5775
PIXEL: 8396/2997
PIXEL: 311/5122
PIXEL: 702/3638
PIXEL: 761/3689
PIXEL: 1143/1040
PIXEL: 3125/4797

C02-00

PIXEL: 638/ 216
PIXEL: 896/2886
PIXEL: 1467/4602
PIXEL: 2018/ 573
PIXEL: 2829/6004
PIXEL: 3024/3113
PIXEL: 3304/3516
PIXEL: 3433/5969
PIXEL: 3707/4204
PIXEL: 4252/1732
PIXEL: 4688/5807
PIXEL: 4957/ 595
PIXEL: 5762/ 619
PIXEL: 7174/4738
PIXEL: 7679/5200
PIXEL: 7723/3209
PIXEL: 221/ 335
PIXEL: 221/ 336
PIXEL: 358/2971
PIXEL: 590/2236
PIXEL: 8286/1297
PIXEL: 8286/1298
PIXEL: 8287/1298
PIXEL: 8298/1432

C02-01

PIXEL: 1034/2775
PIXEL: 1454/3303
PIXEL: 1615/4229
PIXEL: 1710/3217
PIXEL: 2798/4046
PIXEL: 3228/4557
PIXEL: 3369/1730
PIXEL: 3809/3472
PIXEL: 3828/ 811
PIXEL: 4036/3103
PIXEL: 4100/3092
PIXEL: 4221/3644
PIXEL: 5603/3649
PIXEL: 5777/5507
PIXEL: 5917/ 73
PIXEL: 5917/2069
PIXEL: 5917/2251
PIXEL: 5917/4142
PIXEL: 5917/4185
PIXEL: 5917/4605

PIXEL: 5917/4699
PIXEL: 5917/4715
PIXEL: 5917/4786
PIXEL: 5917/4814
PIXEL: 5917/4818
PIXEL: 5917/4901
PIXEL: 5917/5132
PIXEL: 5917/5134
PIXEL: 5917/5172
PIXEL: 5917/5224
PIXEL: 5917/5326
PIXEL: 5917/5374
PIXEL: 5917/5399
PIXEL: 5917/5442
PIXEL: 5917/5460
PIXEL: 5917/5505
PIXEL: 5917/5532
PIXEL: 5917/5703
PIXEL: 5917/5831
PIXEL: 5917/5966
PIXEL: 6140/1501
PIXEL: 6364/ 886
PIXEL: 6368/ 373
PIXEL: 6632/5136
PIXEL: 6892/1877
PIXEL: 7077/3301
PIXEL: 7435/4269
PIXEL: 7470/4152
PIXEL: 7804/5689
PIXEL: 7934/2556
PIXEL: 7947/2682
PIXEL: 8481/5441
PIXEL: 8976/5326

C03-00

PIXEL: 2473/5533
PIXEL: 2803/4729
PIXEL: 3887/3736
PIXEL: 4527/2837
PIXEL: 5267/ 537
PIXEL: 5546/2177
PIXEL: 5548/1900
PIXEL: 6051/5438
PIXEL: 6175/2486
PIXEL: 7085/ 490
PIXEL: 3145/ 552
PIXEL: 3703/2508

PIXEL: 4138/4993
PIXEL: 4138/4994

C04-00

PIXEL: 1096/ 835
PIXEL: 1719/3640
PIXEL: 1760/5267
PIXEL: 2012/4111
PIXEL: 3468/3845
PIXEL: 5884/5941
PIXEL: 6362/3585
PIXEL: 8521/ 438
PIXEL: 518/5069
PIXEL: 518/5070
PIXEL: 1369/1950
PIXEL: 1569/2277
PIXEL: 4448/3260
PIXEL: 4893/2883
PIXEL: 4893/2884
PIXEL: 4894/2884

C05-00

PIXEL: 1096/3016
PIXEL: 2333/5799
PIXEL: 2510/5651
PIXEL: 5790/3354
PIXEL: 5909/1272
PIXEL: 6196/1661
PIXEL: 7127/5306
PIXEL: 7221/5235
PIXEL: 8576/3114
PIXEL: 891/ 736
PIXEL: 891/ 737
PIXEL: 3341/3621
PIXEL: 8555/ 533

C06-00

PIXEL: 606/1918
PIXEL: 1179/ 708
PIXEL: 2831/4819

PIXEL: 5298/ 73
PIXEL: 5745/3063
PIXEL: 5965/2208
PIXEL: 6513/2159
PIXEL: 6596/3379
PIXEL: 6979/3004
PIXEL: 8366/2535
PIXEL: 8490/4650
PIXEL: 8689/1402
PIXEL: 8814/ 737
PIXEL: 7496/2168
PIXEL: 8153/4265

C07-00

PIXEL: 1800/4270
PIXEL: 2847/1696
PIXEL: 4210/5934
PIXEL: 4792/3527
PIXEL: 5414/5127
PIXEL: 5634/5894
PIXEL: 5675/3398
PIXEL: 5726/4482
PIXEL: 6145/1572
PIXEL: 6200/5285
PIXEL: 7444/4037
PIXEL: 8287/4334
PIXEL: 8895/3627
PIXEL: 333/4074
PIXEL: 6498/1041
PIXEL: 7174/2519

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	**18.Aug.2020**		
Radiometric Calibration	**18.Aug.2020**		
Shutter Calibration	**18.Aug.2020**		
Electronics and Sensor Calibration	**18.Aug.2020**		

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.