

- when it has to be **right**



Leica Geosystems

Leica DMC-4

Calibration Certificate

Product	Leica DMC-4
Serial Number	41214
Date	17 March 2025
Inspector	Ivan Belchev



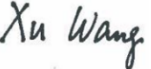
1. System Components

Components	Type	Serial Number
Pod	DMC-4S Pod	41214
GNSS/IMU	Litef LCI-100C 500 Hz	1541-B
Nadir RGB Camera		
Camera Head	CH150L-RGB	L150129
Lens system	D69.112/4.0 112 mm	112132
Left RGB Camera		
Camera Head	CH150L-RGB	L150131
Lens system	D69.112/4.0 112 mm	112135
Right RGB Camera		
Camera Head	CH150L-RGB	L150130
Lens system	D69.112/4.0 112 mm	112133
Left NIR Camera		
Camera Head	CH150S-NIR	NS150124
Lens system	D69.70/4.0-NIR 71 mm	N70126
Right NIR Head		
Camera Head	CH150S-NIR	NS150125
Lens system	D69.70/4.0-NIR 71 mm	N70127

2. Estimation Process

		Passed	Date	Inspector
Image Flight	completed	ok	16.10.2023	Deniz Arslan
Image Quality Check	checked	ok	18.10.2023	Fatih Kaya
Image Calibration	completed	ok	24.10.2023	Ivan Belchev
Image Misalignment Update	completed			

3. Inspectors

Name	Bernhard Riedl	17.03.2025	
Position	Production Manager		
Name	Xu Wang	17.03.2025	
Position	Support Engineer		
Name	Ivan Belchev	17.03.2025	
Position	Workflow Specialist		

4. Remarks

Fixed serial numbers for NIR cameras.

5. Imaging Sensors Estimation Results

The estimation results for the camera head and lens combination are only valid for:

- IMU and Pod as listed in the System Components section.
- Camera Head, lens and specified position as listed in the Estimation Results sections.

5.1 Camera Model of distortion free images

All factory calibration results contain fixed nominal focal lengths and zero principal point offsets. Leica HxMap applies the grid to create distortion-free images of nominal focal length and pixel size.

5.2 Results of Geometric Calibration

5.2.1 Calibration method for Green Reference Band

Estimation of additional parameters (focal length, principal point, radial symmetric distortion, correction grid) and IMU misalignment in simultaneous bundle adjustment

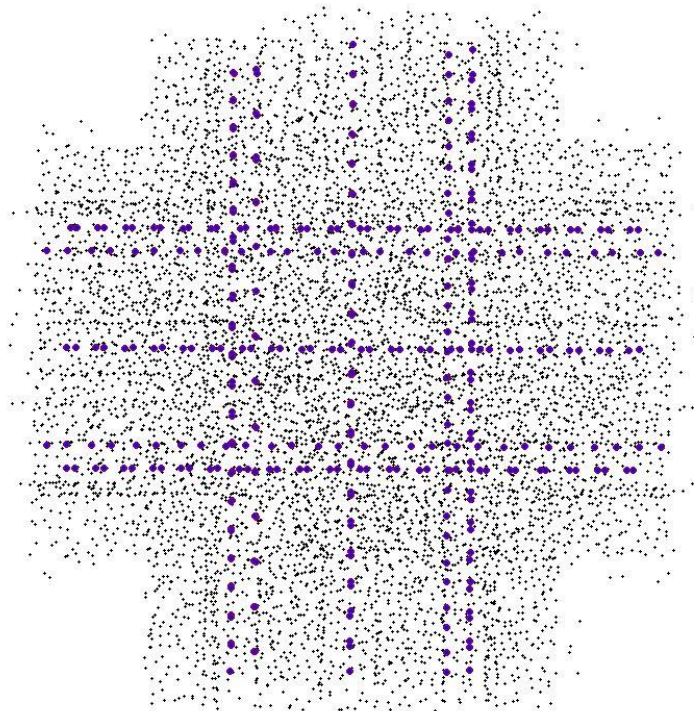
Reference band (green)

Distance [mm]

Resulting sigma naught of bundle adjustment:

0.0010

Final bundle adjustment results after elimination of tie point blunders:



CAP-A Sigma0 : 1.0
Control Points
RMS-X: 0.000
RMS-Y: 0.000
RMS-Z: 0.000
Antenna Centers
RMS-X: 0.013
RMS-Y: 0.016
RMS-Z: 0.021
Variance Comp.
X: 1.000
Y: 1.000
Z: 1.000
O: 1.073
P: 1.094
K: 0.998

5.2.2 Calibration method for NIR Band

Estimation of additional parameters (focal length, principal point, radial symmetric distortion, correction grid) and IMU misalignment in simultaneous bundle adjustment

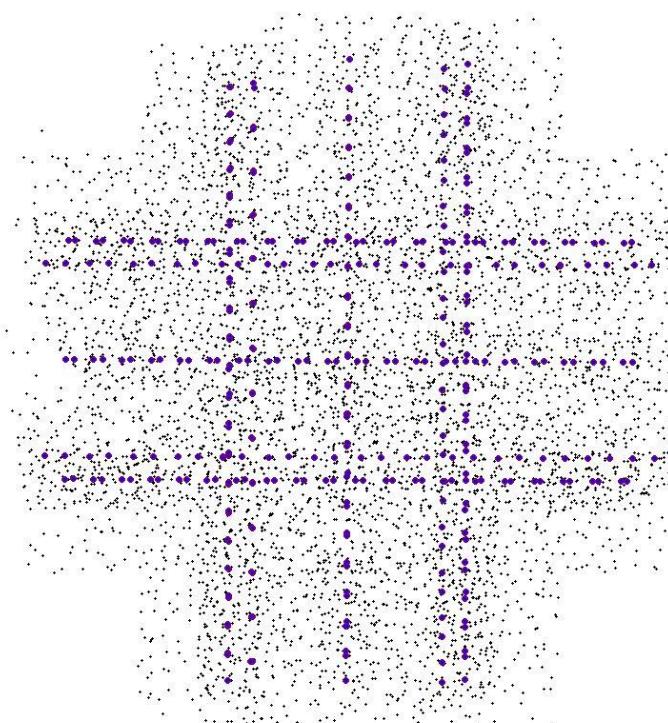
NIR band

Distance [mm]

Resulting sigma naught of bundle adjustment:

0.0012

Final bundle adjustment results after elimination of tie point blunders:



CAPA Sigma0 : 1.2
Control Points
RMS-X: 0.000
RMS-Y: 0.000
RMS-Z: 0.000
Antenna Centers
RMS-X: 0.012
RMS-Y: 0.014
RMS-Z: 0.015
Variance Comp.
X: 1.000
Y: 1.000
Z: 1.000
O: 0.998
P: 0.913
K: 1.001

5.2.3 Camera Parameters for Output Composite Frame

	Value
Nominal Focal Length [mm]	107.0
Pixel size [mm]	0.00376
Rows [pixels]	13440
Columns [pixels]	31520
Nominal Principal Point x [mm]	0.0
Nominal Principal Point y [mm]	0.0

5.3 Estimation Results for Nadir RGB Camera

	Component	Serial Number
Camera Head	CH150L-RGB	L150129
Lens system	D69.112/4.0 112	112132
	mm	
View Direction	Nadir	
Radiometric Calibration Date		09.07.2023
Geometric Calibration Date		20.10.2023
Geometric Calibration File	MFC150_GEO_CH-L150129-C-914608_LENS-112132-D-918062_20231020-100532.xml	

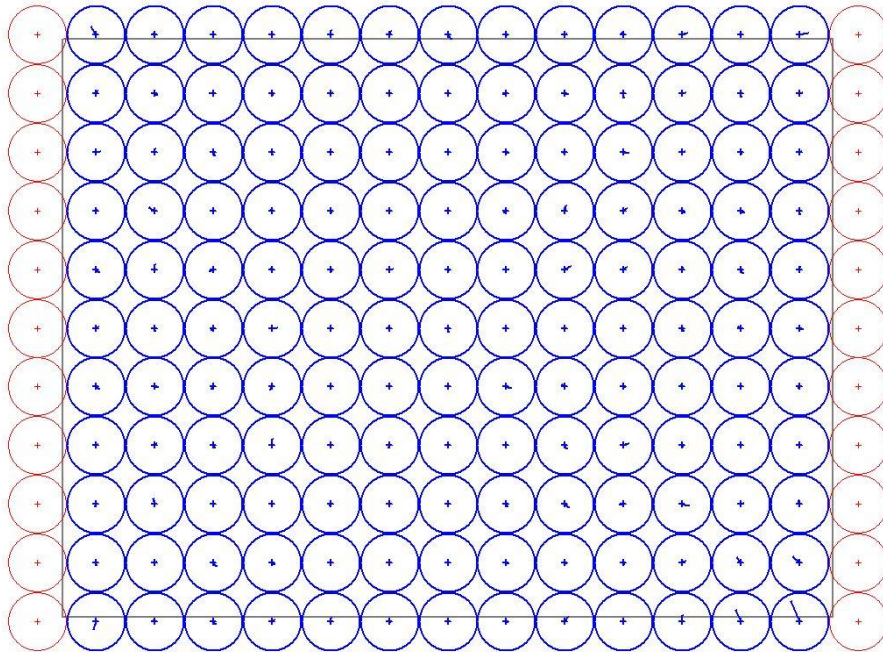
IMU Misalignment [degree]

ω	-0.03636
ϕ	0.06622
κ	-0.03179

		Red	Green	Blue
Calibrated Focal Length [mm]	c	108.684	108.684	108.684
Principal Point [mm]	x	-0.07988	-0.07988	-0.07988
	y	0.06216	0.06216	0.06216
Radial Symmetric Distortion	a0	2.461124E-05	2.461124E-05	2.461124E-05
	a1	8.915644E-10	8.915644E-10	8.915644E-10
	a2	-3.863076E-13	-3.863076E-13	-3.863076E-13

5.3.2 Distortion grid

RMS-X: 0.09
RMS-Y: 0.11



Radius of circles is 0.0010 mm

5.4 Estimation Results for Left RGB Camera

	Component	Serial Number
Camera Head	CH150L-RGB	L150131
Lens system	D69.112/4.0 112 mm	112135
View Direction	Left RGB	
Radiometric Calibration Date		21.09.2023
Geometric Calibration Date		20.10.2023
Geometric Calibration File	MFC150_GEO_CH-L150131-C-914608_LENS-112135-D-918062_20231020-100543.xml	

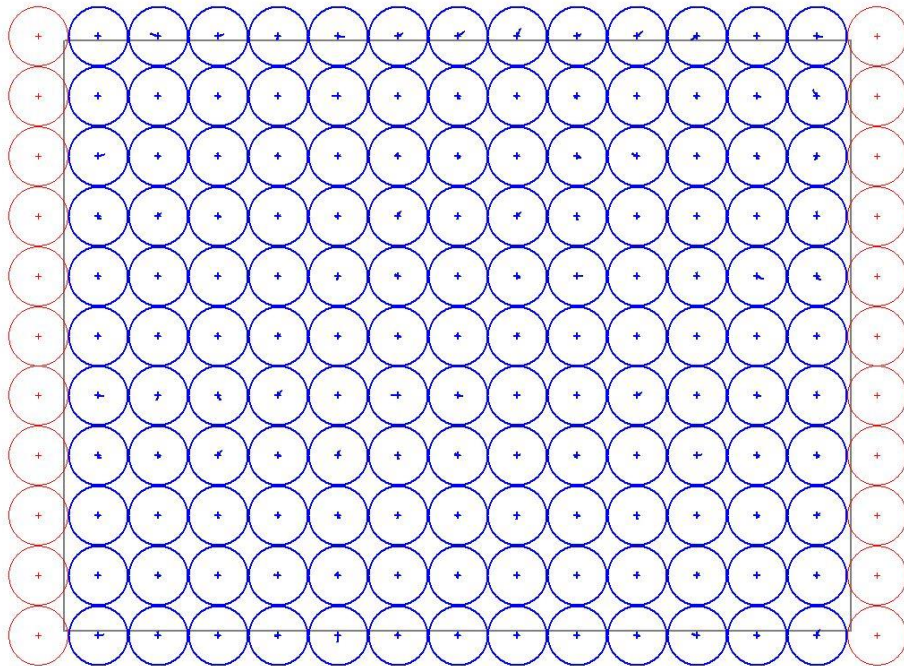
IMU Misalignment [degree]

ω	-0.00537
ϕ	0.02455
κ	0.07453

		Red	Green	Blue
Calibrated Focal Length [mm]	c	108.377	108.377	108.377
Principal Point [mm]	x	0.01475	0.01475	0.01475
	y	-0.07180	-0.07180	-0.07180
Radial Symmetric Distortion	a0	2.495859E-05	2.495859E-05	2.495859E-05
	a1	3.092229E-10	3.092229E-10	3.092229E-10
	a2	-4.085718E-14	-4.085718E-14	-4.085718E-14

5.4.2 Distortion grid

RMS-X: 0.09
RMS-Y: 0.08



Radius of circles is 0.0010 mm

5.5 Estimation Results for Right RGB Camera

	Component	Serial Number
Camera Head	CH150L-RGB	L150130
Lens system	D69.112/4.0 112 mm	112133
View Direction	Right RBG	
Radiometric Calibration Date		09.07.2023
Geometric Calibration Date		20.10.2023
Geometric Calibration File	MFC150_GEO_CH-L150130-C-914608_LENS-112133-D-918062_20231020-100538.xml	

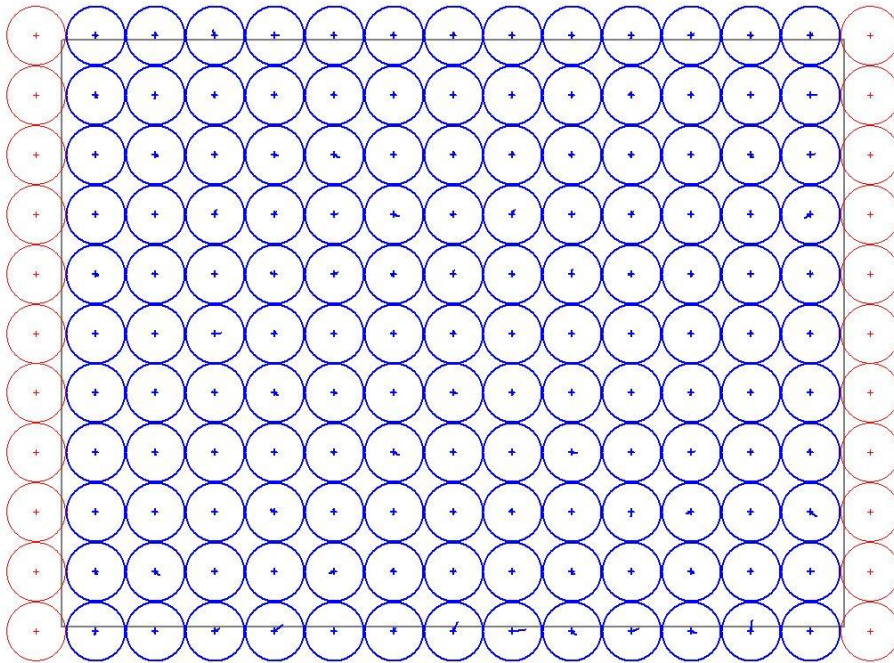
IMU Misalignment [degree]

ω	-0.02325
ϕ	0.01401
κ	-0.06606

		Red	Green	Blue
Calibrated Focal Length [mm]	c	108.491	108.491	108.491
Principal Point [mm]	x	-0.01621	-0.01621	-0.01621
	y	-0.07808	-0.07808	-0.07808
Radial Symmetric Distortion	a0	2.449829E-05	2.449829E-05	2.449829E-05
	a1	9.460261E-10	9.460261E-10	9.460261E-10
	a2	-3.884378E-13	-3.884378E-13	-3.884378E-13

5.5.2 Distortion grid

RMS-X: 0.09
RMS-Y: 0.08



Radius of circles is 0.0010 mm

5.6 Estimation Results for Left NIR Camera

	Component	Serial Number
Camera Head	CH150S-NIR	NS150124
Lens system	D69.70/4.0-NIR	N70126
	71 mm	
View Direction	Left NIR	
Radiometric Calibration Date		22.08.2023
Geometric Calibration Date		24.10.2023
Geometric Calibration File		MFC150_GEO_CH-NS150124-C-914609_LENS-N70126-E-918065_20231024-085628.xml

IMU Misalignment [degree]

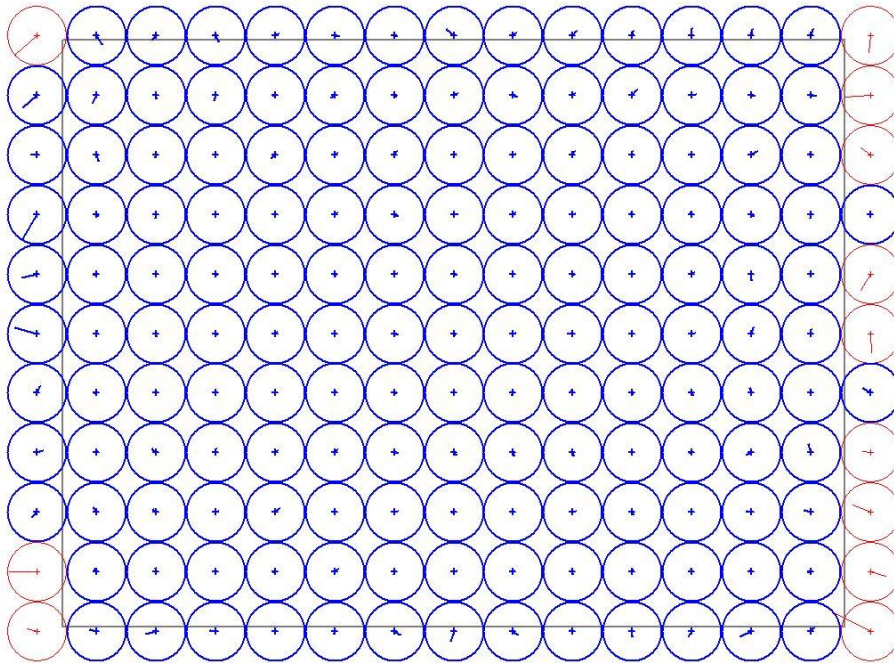
ω	-0.02754
ϕ	-0.01116
κ	-0.12732

NIR

Calibrated Focal Length [mm]	c	69.976
Principal Point [mm]	x	0.00017
	y	0.08804
Radial Symmetric Distortion	a0	-3.590308E-06
	a1	-6.447483E-09
	a2	1.829552E-12

5.6.2 Distortion grid

RMS-X: 0.24
RMS-Y: 0.18



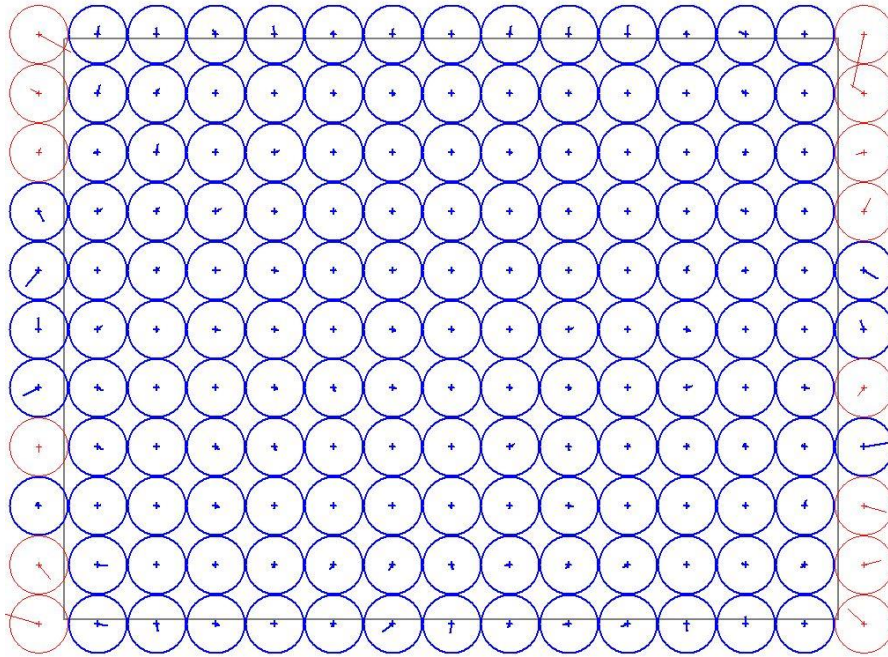
Radius of circles is 0.0010 mm

5.7 Estimation Results for Right NIR Camera

		Component	Serial Number
Camera Head		CH150S-NIR	NS150125
Lens system		D69.70/4.0-NIR	N70127
		71 mm	
View Direction		Right NIR	
Radiometric Calibration Date			21.08.2023
Geometric Calibration Date			24.10.2023
Geometric Calibration File			MFC150_GEO_CH-NS150125-C-914609_LENS-N70127-E-918065_20231024-085634.xml
IMU Misalignment [degree]			
		ω	-0.03198
		ϕ	0.00148
		κ	-0.09535
			NIR
Calibrated Focal Length [mm]	c		69.906
Principal Point [mm]	x		0.00924
	y		0.06025
Radial Symmetric Distortion	a0		-2.943768E-06
	a1		-7.211577E-09
	a2		2.232209E-12

5.7.2 Distortion grid

RMS-X: 0.23
RMS-Y: 0.23



Radius of circles is 0.0010 mm