

Report for Multi-Station Adjustment

Report date: 2025-03-07

Generated by: KCC

Scope: full report

Host application: RiSCAN PRO 2.19

MSA module: 2.13.2-20231124+90b07cd7

Report module: 1.11.1

Platform: Windows-10-10.0.19045-SP0

Hostname: LAP140676

1 Project Summary

Project name: **2024-09-21 B FP 6 28**

Global Coordinate Reference System (GLCS): WGS84 / Geocentric (EPSG::4978)

Report GLCS: WGS84 / UTM zone 47N (EPSG::32647)

Project origin:

Easting [m]: 866692.3463

Northing [m]: 328901.6821

Height [m]: 0.0000

Project Coordinate System (PRCS): levelled Cartesian east, north, up system

GNSS Coordinate Reference Systems:

CRS#1 ... WGS84 / Geographic (EPSG::4979)

Report Coordinate System:

PRCS

number of scan positions: 38

bounding box of scanposition centers: (in PRCS)

direction	from [m]	to [m]	width [m]
east	-5.286	11.161	16.447
north	-32.568	1.721	34.288
height	9.351	14.569	5.219

instruments used:

instrument type: VZ-400i

serial number: H2227243

2 Data available in Project

Control point (CtrlP) – Point of known coordinates and accuracy. Control Points are used in multi-station adjustment / scan data adjustment to register pointclouds to a known control survey.

Check point (ChkP) – Check points are a freely selectable subset of the Control points to verify the success of the adjustment process. Check points are not used for pointcloud registration, but serve as an independent set of control.

2.1 Scandata

Name	Date	Time	Horiz. FoV [deg]	Resolution [mdeg]	Point Count	Image Count	Refl. Scans
ScanPos001	2024-09-21	20:50:03	359.87	30.0	41,435,934	0	0
ScanPos002	2024-09-21	20:52:02	360.00	30.0	38,369,225	0	0
ScanPos003	2024-09-21	20:55:27	359.91	30.0	41,906,337	0	0
ScanPos004	2024-09-21	20:57:14	360.00	30.0	37,653,286	0	0
ScanPos005	2024-09-21	21:01:00	359.89	30.0	41,897,760	0	0
ScanPos006	2024-09-21	21:03:19	360.00	30.0	38,814,368	0	0
ScanPos007	2024-09-21	21:06:46	359.84	30.0	42,198,960	0	0
ScanPos008	2024-09-21	21:08:35	359.95	30.0	39,395,101	0	0
ScanPos009	2024-09-21	21:12:18	359.84	30.0	40,559,596	0	0
ScanPos010	2024-09-21	21:14:06	360.00	30.0	37,644,608	0	0
ScanPos011	2024-09-21	21:17:21	359.87	30.0	40,835,857	0	0
ScanPos012	2024-09-21	21:19:21	360.00	30.0	37,319,598	0	0
ScanPos013	2024-09-21	21:23:18	359.68	30.0	41,044,562	0	0
ScanPos014	2024-09-21	21:25:07	359.90	30.0	37,862,995	0	0
ScanPos015	2024-09-21	21:29:06	359.68	30.0	41,298,841	0	0
ScanPos016	2024-09-21	21:31:05	359.83	30.0	36,477,790	0	0
ScanPos017	2024-09-21	21:35:20	359.82	30.0	39,361,365	0	0
ScanPos018	2024-09-21	21:37:14	360.00	30.0	35,177,673	0	0
ScanPos019	2024-09-21	21:40:51	359.90	30.0	39,453,552	0	0
ScanPos020	2024-09-21	21:42:37	360.00	30.0	37,776,676	0	0
ScanPos021	2024-09-21	21:46:39	359.80	30.0	39,858,825	0	0
ScanPos022	2024-09-21	21:48:44	359.95	30.0	37,546,656	0	0
ScanPos023	2024-09-21	21:53:14	359.61	30.0	42,696,975	0	0
ScanPos024	2024-09-21	21:55:07	359.93	30.0	39,365,056	0	0
ScanPos025	2024-09-21	21:59:16	359.75	30.0	43,546,915	0	0
ScanPos026	2024-09-21	22:01:09	360.00	30.0	40,219,372	0	0
ScanPos027	2024-09-21	22:05:47	359.76	30.0	42,172,287	0	0
ScanPos028	2024-09-21	22:07:34	360.00	30.0	40,160,946	0	0
ScanPos029	2024-09-21	22:12:58	359.75	30.0	40,515,801	0	0
ScanPos030	2024-09-21	22:14:44	359.95	30.0	37,478,669	0	0
ScanPos031	2024-09-21	22:18:13	359.79	30.0	40,337,969	0	0
ScanPos032	2024-09-21	22:20:05	359.97	30.0	36,939,495	0	0
ScanPos033	2024-09-21	22:25:05	359.66	30.0	40,737,842	0	0

Name	Date	Time	Horiz. FoV [deg]	Resolution [mdeg]	Point Count	Image Count	Refl. Scans
ScanPos034	2024-09-21	22:26:54	359.90	30.0	38,050,672	0	0
ScanPos035	2024-09-21	22:31:35	359.77	30.0	42,245,923	0	0
ScanPos036	2024-09-21	22:33:32	359.90	30.0	36,764,949	0	0
ScanPos037	2024-09-21	22:38:22	359.78	30.0	41,280,538	0	0
ScanPos038	2024-09-21	22:40:23	359.89	30.0	38,151,036	0	0
Total					1,504,554,010		

2.2 GNSS Measurements

The VZ-400i acquired no GNSS measurements.

2.3 Orientation Measurements

The VZ-400i acquired the following measurements for roll, pitch and yaw angles (all values in deg).

Name	Roll	Pitch	Yaw	Acc. Roll	Acc. Pitch	Acc. Yaw	PoseEstimation Type
ScanPos001	-2.991	1.598	71.718	0.012	0.012	1.000	dynamic
ScanPos002	103.177	-70.855	-10.763	0.143	0.143	1.000	dynamic
ScanPos003	5.747	4.147	147.123	0.018	0.018	1.000	dynamic
ScanPos004	-77.293	-66.143	-163.978	0.142	0.142	1.000	dynamic
ScanPos005	4.170	-1.681	159.200	0.014	0.014	1.000	dynamic
ScanPos006	-153.195	84.645	140.373	0.142	0.142	1.000	dynamic
ScanPos007	-2.141	6.497	124.796	0.018	0.018	1.000	dynamic
ScanPos008	-81.994	-55.549	177.036	0.143	0.143	1.000	dynamic
ScanPos009	-0.392	8.601	70.478	0.021	0.021	1.000	dynamic
ScanPos010	-77.841	-60.221	127.565	0.140	0.140	1.000	dynamic
ScanPos011	-2.775	-3.947	-90.765	0.015	0.015	1.000	dynamic
ScanPos012	82.017	55.606	-39.596	0.143	0.143	1.000	dynamic
ScanPos013	-0.029	-0.728	-150.801	0.008	0.008	1.000	dynamic
ScanPos014	-142.048	83.382	75.387	0.142	0.142	1.000	dynamic
ScanPos015	-0.335	0.486	-12.592	0.008	0.008	1.000	dynamic
ScanPos016	127.844	80.257	100.104	0.141	0.141	1.000	dynamic
ScanPos017	2.386	0.920	-157.922	0.011	0.011	1.000	dynamic
ScanPos018	-121.742	-80.525	-55.265	0.142	0.142	1.000	dynamic
ScanPos019	4.545	3.366	-174.938	0.016	0.016	1.000	dynamic
ScanPos020	118.906	71.167	-63.312	0.136	0.136	1.000	dynamic
ScanPos021	1.168	4.056	140.821	0.014	0.014	1.000	dynamic
ScanPos022	101.723	-67.587	53.189	0.143	0.143	1.000	dynamic
ScanPos023	6.105	-4.635	-152.748	0.019	0.019	1.000	dynamic
ScanPos024	-142.415	-79.915	-33.172	0.137	0.137	1.000	dynamic
ScanPos025	1.686	-1.819	3.158	0.011	0.011	1.000	dynamic
ScanPos026	97.022	-6.341	-3.505	0.139	0.139	1.000	dynamic

Name	Roll	Pitch	Yaw	Acc. Roll	Acc. Pitch	Acc. Yaw	PoseEstimation Type
ScanPos027	-3.330	-3.294	-157.147	0.014	0.014	1.000	dynamic
ScanPos028	85.534	-8.210	-156.556	0.143	0.143	1.000	dynamic
ScanPos029	4.820	0.461	-140.079	0.015	0.015	1.000	dynamic
ScanPos030	130.911	-81.671	80.874	0.141	0.141	1.000	dynamic
ScanPos031	5.112	1.916	100.721	0.016	0.016	1.000	dynamic
ScanPos032	131.977	80.525	-127.141	0.140	0.140	1.000	dynamic
ScanPos033	5.119	-4.961	-127.390	0.018	0.018	1.000	dynamic
ScanPos034	55.309	80.719	-71.056	0.142	0.142	1.000	dynamic
ScanPos035	7.557	-2.528	-178.445	0.020	0.020	1.000	dynamic
ScanPos036	-137.434	-82.764	-60.477	0.142	0.142	1.000	dynamic
ScanPos037	4.941	-3.852	170.424	0.017	0.017	1.000	dynamic
ScanPos038	143.789	-79.110	22.036	0.136	0.136	1.000	dynamic

2.4 Control Points defined in a coordinate reference system

No Control Points in a coordinate reference system used.

2.5 Check Points defined in a coordinate reference system

No Check Points in a coordinate reference system used.

2.6 Control Points defined in a locally levelled coordinate system

No Control Points in a locally leveled coordinate system used.

2.7 Check Points defined in a locally levelled coordinate system

No Check Points in a locally leveled coordinate system defined.

3 Data used for Multi-station-Adjustment

3.1 Data per Scan Position

Name	Number of Plane Patches			Plane Patches of Phase 3		
	Phase 1	Phase 2	Phase 3	NS	WE	Horiz.
ScanPos001	16,550	3,872	4,064	414	544	1,074
ScanPos002	12,670	2,840	2,980	257	432	801
ScanPos003	16,288	4,026	4,244	440	542	1,140
ScanPos004	11,734	2,978	3,148	357	403	814
ScanPos005	18,846	4,412	4,678	434	656	1,249
ScanPos006	14,764	3,674	3,922	461	656	844
ScanPos007	21,034	4,846	5,102	567	654	1,330
ScanPos008	14,116	3,402	3,526	372	502	889
ScanPos009	16,544	3,724	3,886	489	507	947
ScanPos010	11,690	2,488	2,624	352	334	626

Name	Number of Plane Patches			Plane Patches of Phase 3		
	Phase 1	Phase 2	Phase 3	NS	WE	Horiz.
ScanPos011	11,944	2,492	2,594	377	365	555
ScanPos012	8,168	1,806	1,908	266	271	417
ScanPos013	15,104	3,158	3,356	460	502	716
ScanPos014	13,554	3,068	3,180	469	436	685
ScanPos015	18,978	4,216	4,440	594	600	1,026
ScanPos016	14,014	3,384	3,516	526	523	709
ScanPos017	12,336	2,688	2,846	401	441	581
ScanPos018	10,486	2,262	2,324	345	332	485
ScanPos019	13,888	3,114	3,252	398	436	792
ScanPos020	9,870	2,290	2,354	331	297	549
ScanPos021	9,044	1,824	1,944	228	255	489
ScanPos022	6,874	1,366	1,456	235	147	346
ScanPos023	11,520	2,312	2,448	255	309	660
ScanPos024	7,296	1,430	1,480	175	151	414
ScanPos025	11,030	2,198	2,332	258	309	599
ScanPos026	7,414	1,406	1,462	169	236	326
ScanPos027	10,274	2,056	2,150	207	235	633
ScanPos028	8,588	1,630	1,684	188	196	458
ScanPos029	12,266	2,716	2,844	308	499	615
ScanPos030	9,092	2,112	2,206	251	392	460
ScanPos031	10,446	2,034	2,142	243	360	468
ScanPos032	7,746	1,758	1,846	190	437	296
ScanPos033	11,658	2,548	2,662	324	504	503
ScanPos034	8,164	1,628	1,702	215	328	308
ScanPos035	6,540	1,340	1,376	151	249	288
ScanPos036	4,688	1,010	1,040	151	194	175
ScanPos037	2,798	478	482	39	50	152
ScanPos038	2,780	476	484	38	58	146

NS ... North-South, WE ... West-East, Horiz. ... Horizontal

3.2 Control Points used for Multi-Station Adjustment

No Control Points used.

3.3 Tie Points used for Multi-Station Adjustment

No Tie Points used.

4 Results of MSA

4.1 General Information

User Settings:

use CRS control points: False
use SOCS tie points: False
use LLCS control points: False
GNSS measurement usage: no
gap closure distance: 0.250 m
adjustment effort: extreme
adjustment matches: planes to planes
reporting level: full
initialize optimization with measurements: False
maximum target range: 0.000 m

Observations Used:

project plane patches: 21,773
scan position plane patches: 49,842
GNSS measurements: 0
orientation measurements: 38
control points in CRS: 0
control points in LLCS: 0
tie points in PRCS: 0
LLCS: 0
project northing from: GNSS

Adjustment Info:

start time: 2025-03-07T10:25:04
run time: 00:10:37
parameters estimated: 65,545

4.2 Final Poses of Scan Positions

The following positions and orientations have been estimated for the scan positions:

In the PRCS coordinate system:

Name	X [m]	Y [m]	Z [m]	Acc. X [m]	Acc. Y [m]	Acc. Z [m]
ScanPos001	2.957	2.013	9.627	0.000	0.000	0.000
ScanPos002	2.982	1.721	9.351	0.000	0.000	0.000
ScanPos003	1.456	-2.512	10.210	0.000	0.000	0.000
ScanPos004	1.601	-2.786	9.947	0.000	0.000	0.000
ScanPos005	3.018	-5.211	10.596	0.000	0.000	0.000
ScanPos006	2.911	-5.378	10.324	0.000	0.000	0.000
ScanPos007	5.083	-3.050	10.477	0.000	0.000	0.000
ScanPos008	5.135	-3.350	10.206	0.000	0.000	0.000
ScanPos009	7.499	-3.941	10.437	0.000	0.000	0.000
ScanPos010	7.296	-4.182	10.181	0.000	0.000	0.000

Name	X [m]	Y [m]	Z [m]	Acc. X [m]	Acc. Y [m]	Acc. Z [m]
ScanPos011	11.161	-4.779	10.307	0.000	0.000	0.000
ScanPos012	10.992	-5.034	10.033	0.000	0.000	0.000
ScanPos013	7.425	-7.896	10.771	0.000	0.000	0.000
ScanPos014	7.189	-8.054	10.479	0.000	0.000	0.000
ScanPos015	4.248	-9.287	10.846	0.000	0.000	0.000
ScanPos016	4.505	-9.388	10.548	0.000	0.000	0.000
ScanPos017	7.366	-15.229	11.652	0.000	0.000	0.000
ScanPos018	7.647	-15.179	11.363	0.000	0.000	0.000
ScanPos019	2.251	-13.465	11.334	0.000	0.000	0.000
ScanPos020	1.996	-13.451	11.019	0.000	0.000	0.000
ScanPos021	-0.240	-17.368	12.117	0.000	0.000	0.000
ScanPos022	0.035	-17.476	11.836	0.000	0.000	0.000
ScanPos023	-3.918	-17.231	12.197	0.000	0.000	0.000
ScanPos024	-3.655	-17.199	11.888	0.000	0.000	0.000
ScanPos025	-5.285	-19.590	12.648	0.000	0.000	0.000
ScanPos026	-5.286	-19.859	12.344	0.000	0.000	0.000
ScanPos027	-3.770	-22.055	13.022	0.000	0.000	0.000
ScanPos028	-3.883	-21.782	12.745	0.000	0.000	0.000
ScanPos029	2.387	-21.825	12.620	0.000	0.000	0.000
ScanPos030	2.614	-21.659	12.327	0.000	0.000	0.000
ScanPos031	1.328	-19.416	12.412	0.000	0.000	0.000
ScanPos032	1.258	-19.156	12.111	0.000	0.000	0.000
ScanPos033	3.407	-21.394	12.583	0.000	0.000	0.000
ScanPos034	3.235	-21.643	12.321	0.000	0.000	0.000
ScanPos035	-0.424	-25.876	13.322	0.000	0.000	0.000
ScanPos036	-0.157	-25.963	13.033	0.000	0.000	0.000
ScanPos037	-0.393	-32.515	14.569	0.000	0.000	0.000
ScanPos038	-0.142	-32.568	14.256	0.000	0.000	0.000

Name	Roll [deg]	Pitch [deg]	Yaw [deg]	Acc. Roll [deg]	Acc. Pitch [deg]	Acc. Yaw [deg]
ScanPos001	-3.000	1.602	71.851	0.018	0.018	0.001
ScanPos002	89.003	-71.302	3.736	0.019	0.018	0.004
ScanPos003	5.758	4.154	147.920	0.018	0.018	0.001
ScanPos004	-83.228	-66.539	-155.198	0.018	0.018	0.003
ScanPos005	4.182	-1.692	160.458	0.018	0.018	0.001
ScanPos006	-128.900	86.867	167.036	0.025	0.018	0.018
ScanPos007	-2.151	6.505	124.705	0.018	0.018	0.001
ScanPos008	-88.014	-55.818	-176.156	0.018	0.018	0.002
ScanPos009	-0.388	8.615	71.677	0.018	0.018	0.001
ScanPos010	-81.621	-60.548	128.885	0.018	0.018	0.003
ScanPos011	-2.794	-3.957	-90.617	0.018	0.018	0.001
ScanPos012	88.097	55.876	-36.748	0.018	0.018	0.002

Name	Roll [deg]	Pitch [deg]	Yaw [deg]	Acc. Roll [deg]	Acc. Pitch [deg]	Acc. Yaw [deg]
ScanPos013	-0.046	-0.730	-150.203	0.018	0.018	0.001
ScanPos014	-125.387	84.973	88.541	0.023	0.018	0.013
ScanPos015	-0.335	0.490	-12.989	0.018	0.018	0.001
ScanPos016	117.819	81.302	96.504	0.020	0.018	0.008
ScanPos017	2.386	0.924	-157.346	0.018	0.018	0.001
ScanPos018	-105.677	-81.621	-62.317	0.021	0.018	0.010
ScanPos019	4.547	3.378	-174.794	0.018	0.018	0.001
ScanPos020	115.732	71.685	-72.844	0.019	0.018	0.005
ScanPos021	1.165	4.066	141.669	0.018	0.018	0.001
ScanPos022	90.958	-68.007	69.695	0.019	0.018	0.005
ScanPos023	6.112	-4.646	-152.028	0.018	0.018	0.001
ScanPos024	-137.254	-80.934	-28.814	0.020	0.018	0.008
ScanPos025	1.690	-1.829	2.503	0.018	0.018	0.001
ScanPos026	95.470	-6.346	-2.843	0.018	0.018	0.002
ScanPos027	-3.349	-3.297	-155.973	0.018	0.018	0.001
ScanPos028	89.714	-8.217	-161.043	0.018	0.018	0.002
ScanPos029	4.831	0.471	-140.083	0.018	0.018	0.001
ScanPos030	116.807	-82.917	104.552	0.023	0.018	0.015
ScanPos031	5.121	1.913	102.314	0.018	0.018	0.001
ScanPos032	123.047	81.607	-136.797	0.022	0.018	0.012
ScanPos033	5.129	-4.973	-127.263	0.018	0.018	0.001
ScanPos034	69.890	81.879	-59.520	0.023	0.018	0.014
ScanPos035	7.569	-2.537	-176.752	0.018	0.018	0.002
ScanPos036	-121.092	-84.280	-68.931	0.033	0.018	0.027
ScanPos037	4.947	-3.854	172.212	0.018	0.018	0.002
ScanPos038	139.534	-80.051	34.455	0.023	0.019	0.015

In the coordinate reference system:

Name	Easting [m]	Northing [m]	Height [m]	Acc. East [m]	Acc. North [m]	Acc. Up [m]
ScanPos001	866695.3015	328903.7064	9.6273	0.000	0.000	0.000
ScanPos002	866695.3266	328903.4140	9.3508	0.000	0.000	0.000
ScanPos003	866693.8115	328899.1709	10.2103	0.000	0.000	0.000
ScanPos004	866693.9575	328898.8976	9.9465	0.000	0.000	0.000
ScanPos005	866695.3836	328896.4736	10.5964	0.000	0.000	0.000
ScanPos006	866695.2775	328896.3058	10.3244	0.000	0.000	0.000
ScanPos007	866697.4446	328898.6432	10.4772	0.000	0.000	0.000
ScanPos008	866697.4979	328898.3437	10.2060	0.000	0.000	0.000
ScanPos009	866699.8667	328897.7586	10.4370	0.000	0.000	0.000
ScanPos010	866699.6637	328897.5163	10.1808	0.000	0.000	0.000
ScanPos011	866703.5353	328896.9301	10.3074	0.000	0.000	0.000
ScanPos012	866703.3674	328896.6745	10.0330	0.000	0.000	0.000

Name	Easting [m]	Northing [m]	Height [m]	Acc. East [m]	Acc. North [m]	Acc. Up [m]
ScanPos013	866699.8043	328893.7981	10.7713	0.000	0.000	0.000
ScanPos014	866699.5685	328893.6397	10.4787	0.000	0.000	0.000
ScanPos015	866696.6272	328892.3966	10.8465	0.000	0.000	0.000
ScanPos016	866696.8854	328892.2960	10.5483	0.000	0.000	0.000
ScanPos017	866699.7669	328886.4556	11.6524	0.000	0.000	0.000
ScanPos018	866700.0480	328886.5071	11.3632	0.000	0.000	0.000
ScanPos019	866694.6409	328888.2070	11.3343	0.000	0.000	0.000
ScanPos020	866694.3848	328888.2197	11.0191	0.000	0.000	0.000
ScanPos021	866692.1584	328884.2917	12.1173	0.000	0.000	0.000
ScanPos022	866692.4338	328884.1844	11.8359	0.000	0.000	0.000
ScanPos023	866688.4753	328884.4173	12.1967	0.000	0.000	0.000
ScanPos024	866688.7380	328884.4503	11.8881	0.000	0.000	0.000
ScanPos025	866687.1132	328882.0520	12.6484	0.000	0.000	0.000
ScanPos026	866687.1126	328881.7825	12.3438	0.000	0.000	0.000
ScanPos027	866688.6375	328879.5883	13.0216	0.000	0.000	0.000
ScanPos028	866688.5235	328879.8611	12.7447	0.000	0.000	0.000
ScanPos029	866694.8013	328879.8363	12.6205	0.000	0.000	0.000
ScanPos030	866695.0285	328880.0039	12.3269	0.000	0.000	0.000
ScanPos031	866693.7343	328882.2457	12.4121	0.000	0.000	0.000
ScanPos032	866693.6631	328882.5062	12.1115	0.000	0.000	0.000
ScanPos033	866695.8219	328880.2709	12.5834	0.000	0.000	0.000
ScanPos034	866695.6498	328880.0220	12.3215	0.000	0.000	0.000
ScanPos035	866691.9988	328875.7722	13.3219	0.000	0.000	0.000
ScanPos036	866692.2663	328875.6865	13.0326	0.000	0.000	0.000
ScanPos037	866692.0500	328869.1255	14.5695	0.000	0.000	0.000
ScanPos038	866692.3012	328869.0732	14.2556	0.000	0.000	0.000

4.3 Changes in Scan Positions

The following table reflects the change of scan positions with respect to position and orientation in comparison to positions and orientations wrt to prior to multi-station adjustment.

In the PRCS coordinate system:

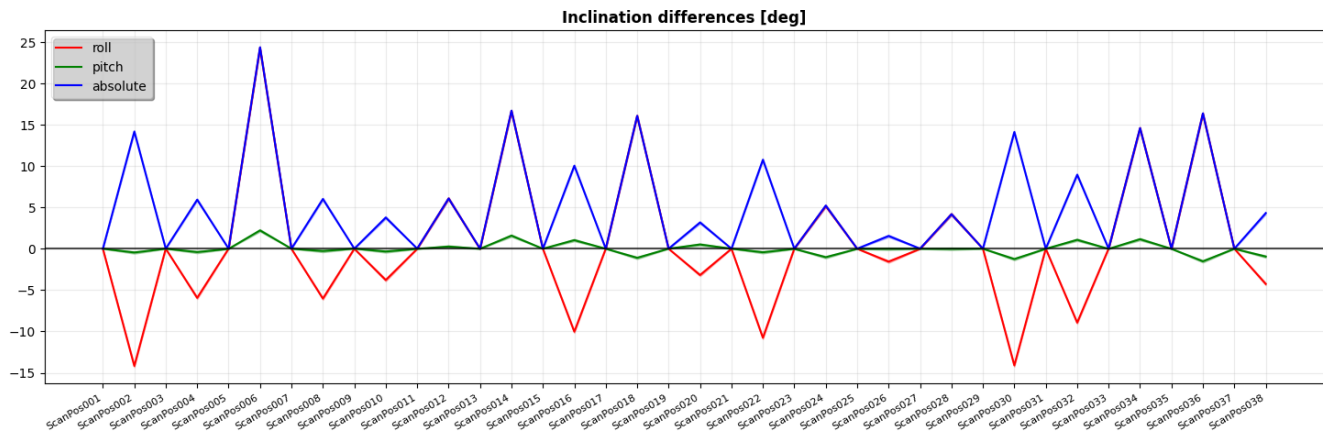
Name	Changes wrt to prior to multi-station adjustment					
	X [m]	Y [m]	Z [m]	Roll [deg]	Pitch [deg]	Yaw [deg]
ScanPos001	0.0000	0.0004	-0.0001	0.0004	0.0003	0.0034
ScanPos002	0.0000	0.0004	-0.0001	-0.0007	0.0007	0.0042
ScanPos003	0.0002	0.0003	-0.0001	0.0007	-0.0005	0.0035
ScanPos004	0.0002	0.0003	-0.0001	0.0009	-0.0006	0.0030
ScanPos005	0.0004	0.0005	-0.0000	0.0011	-0.0000	0.0031
ScanPos006	0.0004	0.0004	-0.0000	0.0029	-0.0007	0.0064
ScanPos007	0.0003	0.0005	-0.0001	0.0007	0.0001	0.0037
ScanPos008	0.0003	0.0005	-0.0001	0.0003	-0.0001	0.0036

Changes wrt to prior to multi-station adjustment						
Name	X [m]	Y [m]	Z [m]	Roll [deg]	Pitch [deg]	Yaw [deg]
ScanPos009	0.0004	0.0007	-0.0001	0.0003	-0.0002	0.0033
ScanPos010	0.0003	0.0007	-0.0001	-0.0009	-0.0002	0.0045
ScanPos011	0.0004	0.0008	-0.0001	0.0001	-0.0003	0.0033
ScanPos012	0.0003	0.0008	-0.0001	0.0013	0.0007	0.0046
ScanPos013	0.0005	0.0006	-0.0000	-0.0001	0.0001	0.0035
ScanPos014	0.0006	0.0006	-0.0001	-0.0021	0.0003	0.0015
ScanPos015	0.0007	0.0004	-0.0001	-0.0001	-0.0000	0.0036
ScanPos016	0.0007	0.0005	-0.0002	0.0026	-0.0003	0.0060
ScanPos017	0.0011	0.0006	0.0001	0.0009	-0.0006	0.0036
ScanPos018	0.0011	0.0006	0.0001	-0.0054	-0.0011	0.0088
ScanPos019	0.0010	0.0003	-0.0001	-0.0005	0.0004	0.0037
ScanPos020	0.0008	0.0004	-0.0001	-0.0027	0.0000	0.0003
ScanPos021	0.0011	0.0003	-0.0002	-0.0003	-0.0017	0.0034
ScanPos022	0.0013	0.0002	0.0001	-0.0017	-0.0002	0.0063
ScanPos023	0.0012	-0.0000	-0.0002	0.0001	0.0008	0.0037
ScanPos024	0.0014	-0.0002	-0.0002	-0.0002	-0.0008	0.0040
ScanPos025	0.0013	-0.0001	-0.0003	0.0010	-0.0010	0.0036
ScanPos026	0.0013	-0.0002	-0.0003	0.0013	-0.0020	0.0035
ScanPos027	0.0014	0.0000	-0.0002	-0.0000	0.0012	0.0024
ScanPos028	0.0015	-0.0000	-0.0003	-0.0001	0.0006	0.0038
ScanPos029	0.0015	0.0004	-0.0002	0.0011	0.0010	0.0038
ScanPos030	0.0016	0.0004	-0.0002	-0.0018	0.0007	0.0055
ScanPos031	0.0016	0.0002	-0.0001	0.0021	-0.0011	0.0053
ScanPos032	0.0014	0.0002	-0.0003	0.0069	-0.0011	0.0102
ScanPos033	0.0014	0.0003	-0.0001	0.0009	-0.0010	0.0025
ScanPos034	0.0011	-0.0002	-0.0001	-0.0007	-0.0016	0.0014
ScanPos035	0.0017	0.0002	-0.0001	0.0002	0.0004	0.0031
ScanPos036	0.0016	-0.0001	-0.0004	-0.0108	-0.0008	0.0146
ScanPos037	0.0020	0.0004	-0.0002	0.0002	0.0006	0.0036
ScanPos038	0.0020	0.0004	-0.0002	-0.0017	-0.0003	0.0046

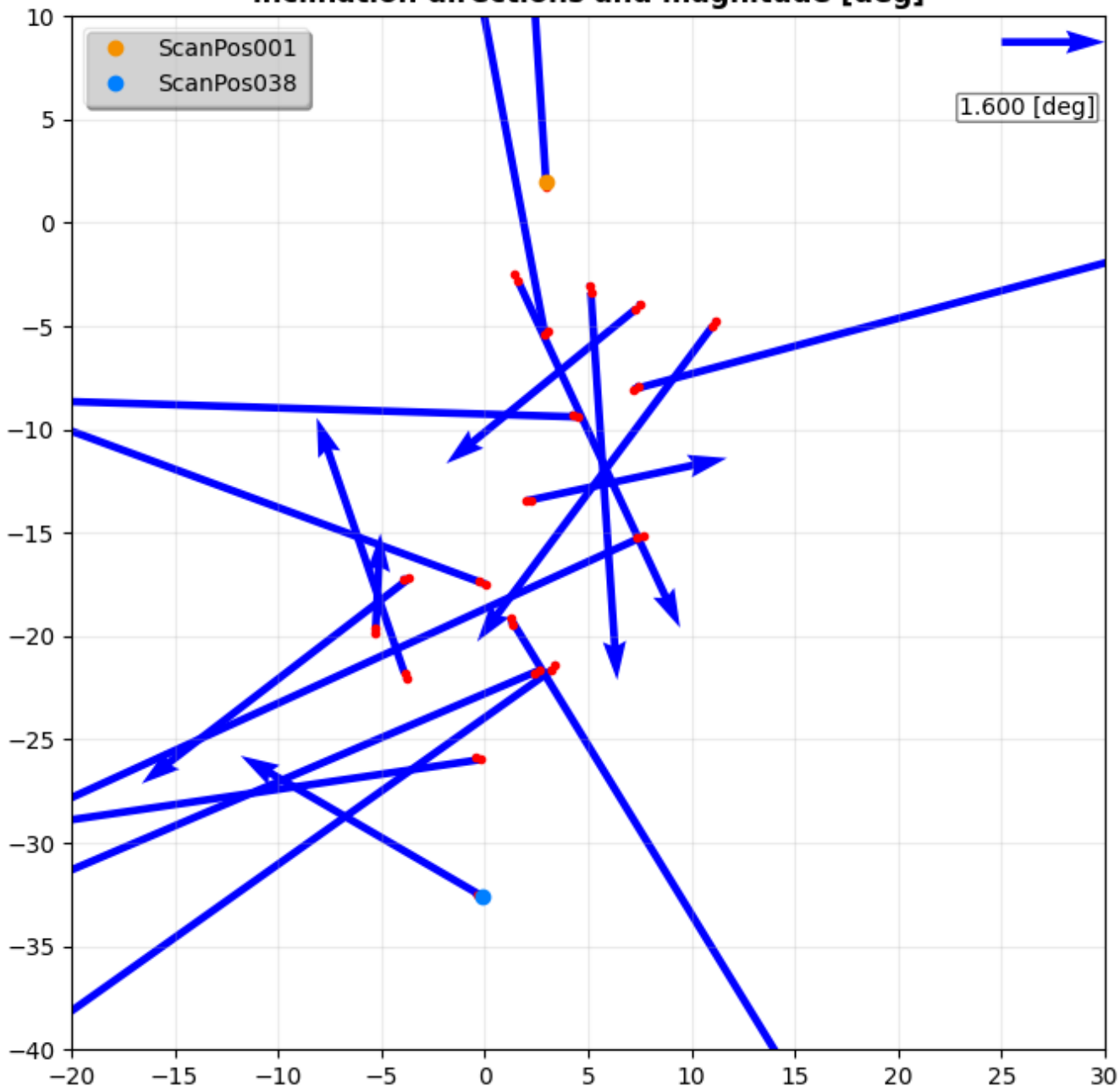
4.4 Residuals

For an assessment of the quality of the multi-station adjustment the following residual deviations (in short residuals) can be observed.

4.4.1 Orientation Measurements



inclination directions and magnitude [deg]



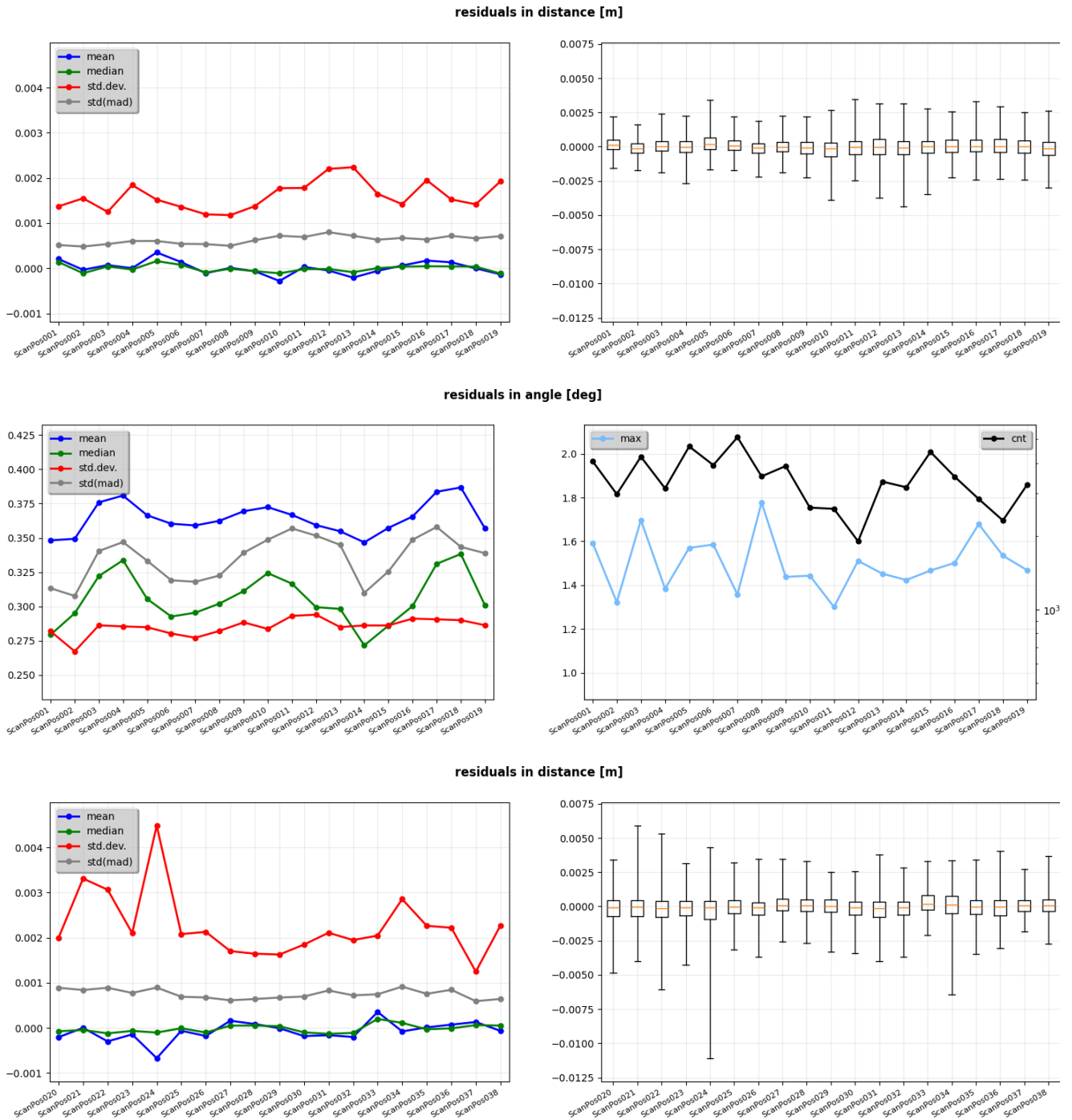
Name	Deviations in PRCS			a priori Accuracies		
	Roll [deg]	Pitch [deg]	Yaw [deg]	Roll [deg]	Pitch [deg]	Yaw [deg]
ScanPos001	-0.0088	0.0040	0.1331	0.012	0.012	10.000
ScanPos002	-14.1740	-0.4474	14.4989	0.143	0.143	10.000
ScanPos003	0.0102	0.0070	0.7961	0.018	0.018	10.000
ScanPos004	-5.9348	-0.3958	8.7797	0.142	0.142	10.000
ScanPos005	0.0127	-0.0117	1.2582	0.014	0.014	10.000
ScanPos006	24.2952	2.2215	26.6623	0.142	0.142	10.000
ScanPos007	-0.0099	0.0075	-0.0911	0.018	0.018	10.000
ScanPos008	-6.0204	-0.2688	6.8073	0.143	0.143	10.000
ScanPos009	0.0034	0.0136	1.1983	0.021	0.021	10.000

Name	Deviations in PRCS			a priori Accuracies			
	Roll [deg]	Pitch [deg]	Yaw [deg]	Roll [deg]	Pitch [deg]	Yaw [deg]	
ScanPos010	-3.7803	-0.3262	1.3204	0.140	0.140	10.000	
ScanPos011	-0.0197	-0.0101	0.1482	0.015	0.015	10.000	
ScanPos012	6.0795	0.2705	2.8473	0.143	0.143	10.000	
ScanPos013	-0.0166	-0.0020	0.5978	0.008	0.008	10.000	
ScanPos014	16.6614	1.5903	13.1534	0.142	0.142	10.000	
ScanPos015	-0.0000	0.0044	-0.3970	0.008	0.008	10.000	
ScanPos016	-10.0255	1.0449	-3.6001	0.141	0.141	10.000	
ScanPos017	-0.0001	0.0044	0.5766	0.011	0.011	10.000	
ScanPos018	16.0650	-1.0962	-7.0522	0.142	0.142	10.000	
ScanPos019	0.0024	0.0121	0.1430	0.016	0.016	10.000	
ScanPos020	-3.1737	0.5180	-9.5320	0.136	0.136	10.000	
ScanPos021	-0.0029	0.0104	0.8477	0.014	0.014	10.000	
ScanPos022	-10.7648	-0.4199	16.5058	0.143	0.143	10.000	
ScanPos023	0.0077	-0.0104	0.7198	0.019	0.019	10.000	
ScanPos024	5.1616	-1.0191	4.3586	0.137	0.137	10.000	
ScanPos025	0.0044	-0.0099	-0.6543	0.011	0.011	10.000	
ScanPos026	-1.5524	-0.0047	0.6618	0.139	0.139	10.000	
ScanPos027	-0.0191	-0.0029	1.1735	0.014	0.014	10.000	
ScanPos028	4.1799	-0.0073	-4.4872	0.143	0.143	10.000	
ScanPos029	0.0109	0.0099	-0.0043	0.015	0.015	10.000	
ScanPos030	-14.1043	-1.2456	23.6775	0.141	0.141	10.000	
ScanPos031	0.0092	-0.0026	1.5924	0.016	0.016	10.000	
ScanPos032	-8.9298	1.0825	-9.6553	0.140	0.140	10.000	
ScanPos033	0.0096	-0.0124	0.1268	0.018	0.018	10.000	
ScanPos034	14.5808	1.1594	11.5353	0.142	0.142	10.000	
ScanPos035	0.0121	-0.0092	1.6921	0.020	0.020	10.000	
ScanPos036	16.3419	-1.5156	-8.4542	0.142	0.142	10.000	
ScanPos037	0.0059	-0.0015	1.7876	0.017	0.017	10.000	
ScanPos038	-4.2548	-0.9414	12.4195	0.136	0.136	10.000	
Statistics	mean	median	std. dev.	std(mad)	min	max	count
Roll [deg]	0.5437	0.0012	8.0912	1.1672	-14.1740	24.2952	38
Pitch [deg]	0.0053	-0.0028	0.7090	0.0209	-1.5156	2.2215	38
Yaw [deg]	2.9498	0.8219	7.9325	1.6195	-9.6553	26.6623	38
Roll [1]	3.744	0.076	57.051	9.901	-99.782	170.602	38
Pitch [1]	0.034	-0.130	5.040	1.254	-10.708	15.600	38
Yaw [1]	0.295	0.082	0.793	0.162	-0.966	2.666	38

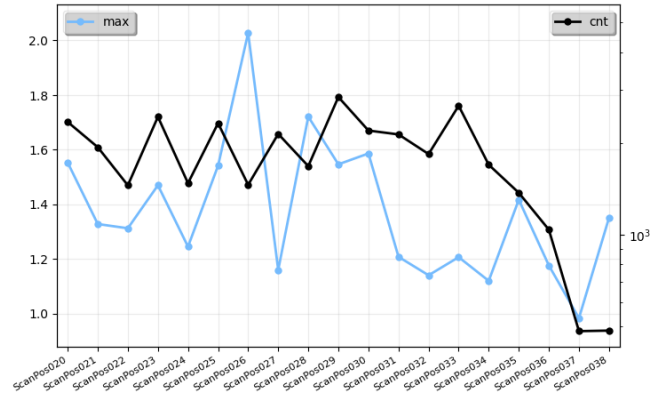
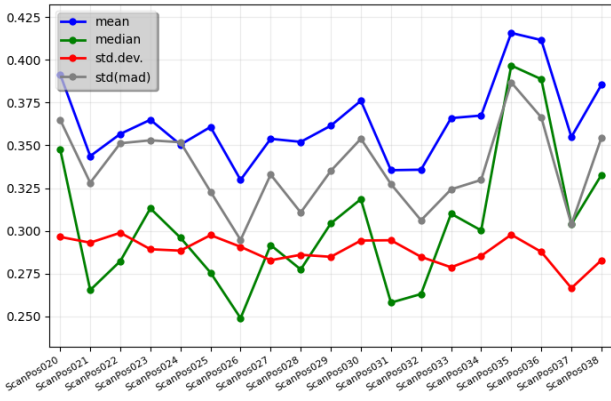
4.4.2 Plane Patches

The subsequent figures show the residuals in distance and angle of all plane patches per scan position, expressed as mean, median, standard deviation and median absolute deviation (std(mad)). Additionally, the figures depict the number of plane patches available for every scan position.

For the residuals in distance of the plane patches the boxplot shows the median as orange line. The box is defined by the quantil 25% and 75%. This translates to 50 percent of the total amount of points lie in the range shown by the box. The whiskers are at the quantil 2.5% and 97.5%, containing 95% of all points.



residuals in angle [deg]



Plane Patch Residuals of Distance [m]											
Name	# plane patches	mean	median	std. dev.	std(mad)	min	q2.5%	q25%	q75%	q97.5%	max
ScanPos001	4064	0.0002	0.0001	0.0014	0.0005	-0.0190	-0.0015	-0.0002	0.0005	0.0022	0.0255
ScanPos002	2980	-0.0000	-0.0001	0.0015	0.0005	-0.0101	-0.0017	-0.0004	0.0002	0.0016	0.0264
ScanPos003	4244	0.0001	0.0000	0.0012	0.0005	-0.0251	-0.0019	-0.0003	0.0004	0.0024	0.0149
ScanPos004	3148	0.0000	-0.0000	0.0018	0.0006	-0.0346	-0.0027	-0.0004	0.0004	0.0023	0.0238
ScanPos005	4678	0.0004	0.0002	0.0015	0.0006	-0.0111	-0.0017	-0.0002	0.0007	0.0034	0.0324
ScanPos006	3922	0.0001	0.0001	0.0014	0.0005	-0.0096	-0.0017	-0.0003	0.0005	0.0022	0.0420
ScanPos007	5102	-0.0001	-0.0001	0.0012	0.0005	-0.0122	-0.0022	-0.0005	0.0003	0.0019	0.0147
ScanPos008	3526	0.0000	-0.0000	0.0012	0.0005	-0.0123	-0.0019	-0.0003	0.0003	0.0022	0.0131
ScanPos009	3886	-0.0001	-0.0001	0.0014	0.0006	-0.0139	-0.0022	-0.0005	0.0003	0.0022	0.0308
ScanPos010	2624	-0.0003	-0.0001	0.0018	0.0007	-0.0195	-0.0039	-0.0007	0.0003	0.0027	0.0138
ScanPos011	2594	0.0000	-0.0000	0.0018	0.0007	-0.0155	-0.0025	-0.0006	0.0004	0.0035	0.0234
ScanPos012	1908	-0.0000	-0.0000	0.0022	0.0008	-0.0278	-0.0037	-0.0005	0.0005	0.0032	0.0185
ScanPos013	3356	-0.0002	-0.0001	0.0022	0.0007	-0.0283	-0.0044	-0.0006	0.0004	0.0032	0.0143
ScanPos014	3180	-0.0001	0.0000	0.0016	0.0006	-0.0098	-0.0035	-0.0004	0.0004	0.0028	0.0199
ScanPos015	4440	0.0001	0.0000	0.0014	0.0007	-0.0119	-0.0023	-0.0004	0.0005	0.0026	0.0266
ScanPos016	3516	0.0002	0.0000	0.0020	0.0006	-0.0115	-0.0024	-0.0004	0.0005	0.0033	0.0297
ScanPos017	2846	0.0001	0.0000	0.0015	0.0007	-0.0143	-0.0024	-0.0004	0.0006	0.0029	0.0150
ScanPos018	2324	-0.0000	0.0000	0.0014	0.0007	-0.0158	-0.0024	-0.0004	0.0004	0.0025	0.0116
ScanPos019	3252	-0.0001	-0.0001	0.0019	0.0007	-0.0379	-0.0030	-0.0006	0.0003	0.0026	0.0245
ScanPos020	2354	-0.0002	-0.0001	0.0020	0.0009	-0.0220	-0.0049	-0.0007	0.0004	0.0034	0.0160
ScanPos021	1944	0.0000	-0.0000	0.0033	0.0008	-0.0370	-0.0040	-0.0007	0.0005	0.0059	0.0260
ScanPos022	1456	-0.0003	-0.0001	0.0031	0.0009	-0.0256	-0.0061	-0.0008	0.0004	0.0053	0.0191
ScanPos023	2448	-0.0001	-0.0001	0.0021	0.0008	-0.0320	-0.0043	-0.0006	0.0004	0.0032	0.0198
ScanPos024	1480	-0.0007	-0.0001	0.0045	0.0009	-0.0390	-0.0111	-0.0010	0.0004	0.0043	0.0349
ScanPos025	2332	-0.0001	-0.0000	0.0021	0.0007	-0.0227	-0.0032	-0.0005	0.0004	0.0032	0.0234
ScanPos026	1462	-0.0002	-0.0001	0.0021	0.0007	-0.0157	-0.0037	-0.0006	0.0003	0.0035	0.0205
ScanPos027	2150	0.0002	0.0001	0.0017	0.0006	-0.0114	-0.0026	-0.0003	0.0005	0.0035	0.0267
ScanPos028	1684	0.0001	0.0001	0.0016	0.0006	-0.0126	-0.0027	-0.0004	0.0005	0.0033	0.0171
ScanPos029	2844	-0.0000	0.0000	0.0016	0.0007	-0.0216	-0.0033	-0.0004	0.0005	0.0025	0.0183

		Plane Patch Residuals of Distance [m]									
Name	# plane patches	mean	median	std. dev.	std(mad)	min	q2.5%	q25%	q75%	q97.5%	max
ScanPos030	2206	-0.0002	-0.0001	0.0018	0.0007	-0.0169	-0.0034	-0.0006	0.0003	0.0025	0.0227
ScanPos031	2142	-0.0002	-0.0001	0.0021	0.0008	-0.0154	-0.0040	-0.0007	0.0004	0.0038	0.0224
ScanPos032	1846	-0.0002	-0.0001	0.0019	0.0007	-0.0123	-0.0037	-0.0006	0.0003	0.0028	0.0241
ScanPos033	2662	0.0004	0.0002	0.0020	0.0007	-0.0208	-0.0021	-0.0002	0.0008	0.0033	0.0403
ScanPos034	1702	-0.0001	0.0001	0.0029	0.0009	-0.0267	-0.0065	-0.0005	0.0008	0.0033	0.0235
ScanPos035	1376	0.0000	-0.0000	0.0023	0.0008	-0.0142	-0.0035	-0.0005	0.0005	0.0034	0.0285
ScanPos036	1040	0.0001	-0.0000	0.0022	0.0008	-0.0063	-0.0030	-0.0006	0.0005	0.0040	0.0232
ScanPos037	482	0.0001	0.0001	0.0012	0.0006	-0.0030	-0.0018	-0.0003	0.0004	0.0027	0.0104
ScanPos038	484	-0.0001	0.0001	0.0023	0.0006	-0.0210	-0.0027	-0.0004	0.0005	0.0037	0.0062
		Plane Patch Angular Residuals [deg]									
Name	# plane patches	mean	median	std. dev.	std(mad)	min	q2.5%	q25%	q75%	q97.5%	max
ScanPos001	4064	0.3482	0.2794	0.2819	0.3133	0.0007	0.0086	0.0949	0.5621	0.9134	1.5930
ScanPos002	2980	0.3493	0.2950	0.2672	0.3077	0.0001	0.0096	0.1160	0.5552	0.9058	1.3229
ScanPos003	4244	0.3759	0.3222	0.2862	0.3404	0.0002	0.0076	0.1170	0.6054	0.9241	1.6974
ScanPos004	3148	0.3808	0.3337	0.2855	0.3469	0.0014	0.0107	0.1235	0.6124	0.9311	1.3841
ScanPos005	4678	0.3665	0.3055	0.2849	0.3334	0.0004	0.0075	0.1073	0.5907	0.9223	1.5706
ScanPos006	3922	0.3603	0.2926	0.2803	0.3191	0.0007	0.0126	0.1096	0.5810	0.9205	1.5857
ScanPos007	5102	0.3590	0.2954	0.2772	0.3180	0.0004	0.0114	0.1111	0.5759	0.9121	1.3577
ScanPos008	3526	0.3624	0.3021	0.2822	0.3225	0.0008	0.0140	0.1138	0.5811	0.9271	1.7777
ScanPos009	3886	0.3694	0.3112	0.2884	0.3391	0.0006	0.0076	0.1069	0.6024	0.9433	1.4379
ScanPos010	2624	0.3724	0.3243	0.2836	0.3486	0.0001	0.0101	0.1157	0.5961	0.9315	1.4438
ScanPos011	2594	0.3667	0.3166	0.2931	0.3569	0.0006	0.0068	0.0959	0.6095	0.9397	1.3009
ScanPos012	1908	0.3593	0.2995	0.2940	0.3516	0.0009	0.0042	0.0860	0.5920	0.9245	1.5115
ScanPos013	3356	0.3548	0.2982	0.2849	0.3449	0.0007	0.0086	0.0905	0.5714	0.9317	1.4531
ScanPos014	3180	0.3467	0.2716	0.2862	0.3099	0.0006	0.0089	0.0941	0.5669	0.9219	1.4239
ScanPos015	4440	0.3573	0.2860	0.2861	0.3255	0.0005	0.0104	0.0988	0.5803	0.9260	1.4671
ScanPos016	3516	0.3655	0.3003	0.2911	0.3486	0.0008	0.0097	0.0976	0.6044	0.9320	1.5020
ScanPos017	2846	0.3836	0.3311	0.2906	0.3579	0.0004	0.0102	0.1142	0.6143	0.9201	1.6785
ScanPos018	2324	0.3867	0.3382	0.2900	0.3434	0.0012	0.0118	0.1274	0.6271	0.9499	1.5351
ScanPos019	3252	0.3569	0.3008	0.2863	0.3388	0.0004	0.0072	0.0942	0.5825	0.9371	1.4691
ScanPos020	2354	0.3915	0.3478	0.2964	0.3650	0.0012	0.0091	0.1253	0.6232	0.9464	1.5529
ScanPos021	1944	0.3437	0.2654	0.2931	0.3281	0.0010	0.0043	0.0783	0.5786	0.9388	1.3283
ScanPos022	1456	0.3567	0.2823	0.2989	0.3512	0.0003	0.0042	0.0819	0.6077	0.9597	1.3128
ScanPos023	2448	0.3649	0.3131	0.2892	0.3529	0.0010	0.0086	0.1034	0.5969	0.9286	1.4701
ScanPos024	1480	0.3504	0.2960	0.2884	0.3518	0.0003	0.0059	0.0754	0.5978	0.9104	1.2456
ScanPos025	2332	0.3607	0.2756	0.2975	0.3229	0.0006	0.0078	0.0916	0.6004	0.9506	1.5418
ScanPos026	1462	0.3298	0.2489	0.2907	0.2947	0.0014	0.0069	0.0808	0.5362	0.9304	2.0275
ScanPos027	2150	0.3538	0.2917	0.2828	0.3329	0.0006	0.0084	0.0963	0.5809	0.9233	1.1600
ScanPos028	1684	0.3520	0.2774	0.2860	0.3107	0.0017	0.0109	0.1005	0.5746	0.9237	1.7211
ScanPos029	2844	0.3615	0.3043	0.2848	0.3351	0.0006	0.0116	0.1017	0.5805	0.9342	1.5467

		Plane Patch Angular Residuals [deg]									
Name	# plane patches	mean	median	std. dev.	std(mad)	min	q2.5%	q25%	q75%	q97.5%	max
ScanPos030	2206	0.3761	0.3185	0.2943	0.3538	0.0020	0.0099	0.1021	0.6071	0.9453	1.5864
ScanPos031	2142	0.3355	0.2580	0.2945	0.3274	0.0007	0.0046	0.0651	0.5582	0.9391	1.2083
ScanPos032	1846	0.3358	0.2630	0.2848	0.3062	0.0006	0.0076	0.0841	0.5536	0.9235	1.1408
ScanPos033	2662	0.3659	0.3100	0.2787	0.3243	0.0007	0.0116	0.1185	0.5691	0.9381	1.2071
ScanPos034	1702	0.3674	0.3002	0.2854	0.3298	0.0006	0.0133	0.1087	0.6021	0.9298	1.1205
ScanPos035	1376	0.4157	0.3967	0.2978	0.3868	0.0013	0.0131	0.1318	0.6504	0.9651	1.4174
ScanPos036	1040	0.4116	0.3887	0.2877	0.3663	0.0004	0.0163	0.1593	0.6447	0.9464	1.1766
ScanPos037	482	0.3549	0.3039	0.2665	0.3037	0.0003	0.0077	0.1161	0.5837	0.9112	0.9839
ScanPos038	484	0.3854	0.3327	0.2829	0.3545	0.0012	0.0117	0.1395	0.5993	0.9420	1.3511