

Report for Multi-Station Adjustment

Report date: 2024-11-24

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 19 14 12**

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

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

Project origin:

Easting [m]: 866703.4123

Northing [m]: 328933.9937

Height [m]: 126.3173

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: 42

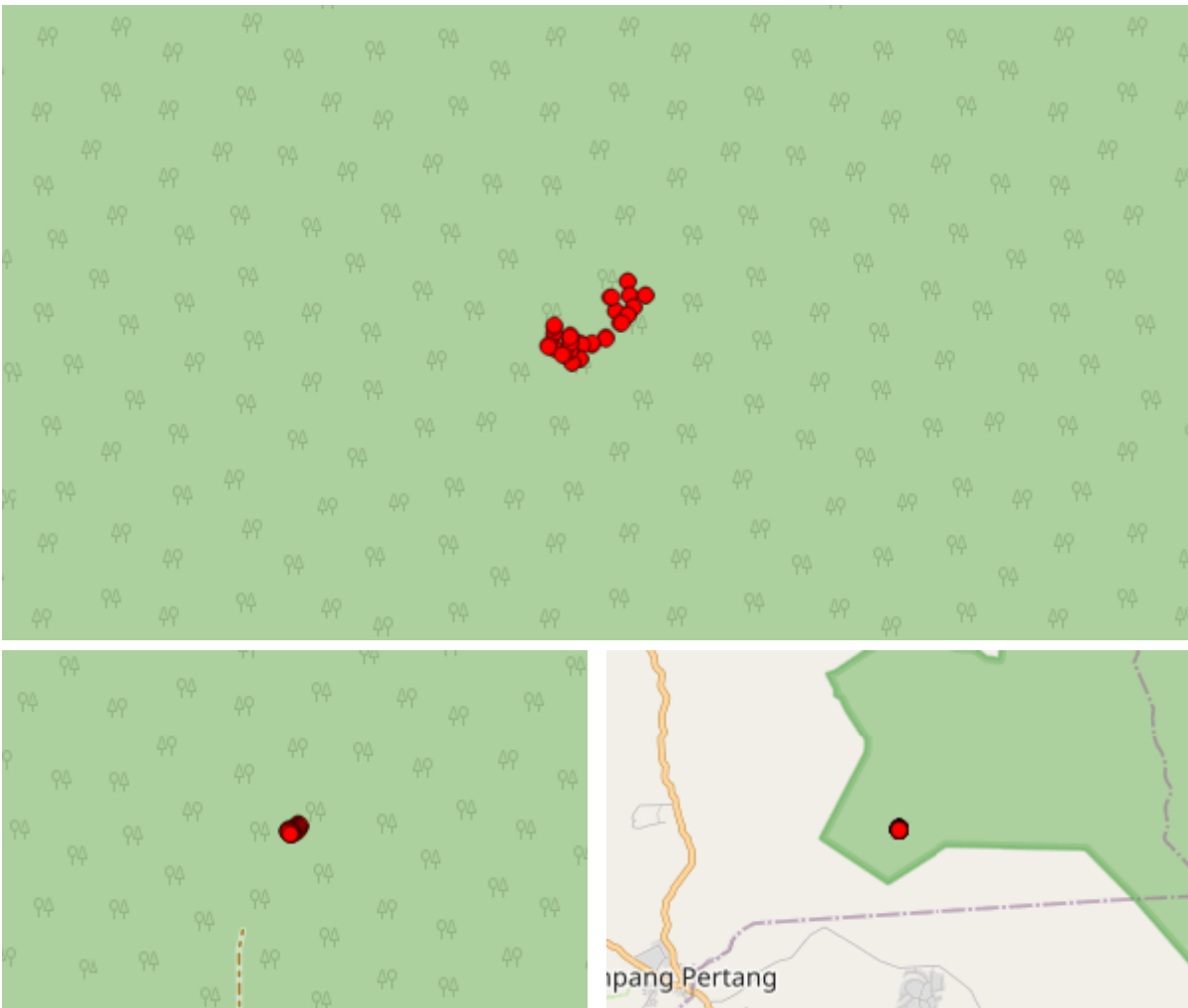
bounding box of scanposition centers: (in PRCS)

| direction | from [m] | to [m] | width [m] |
|-----------|----------|--------|-----------|
| east | -18.477 | 10.669 | 29.147 |
| north | -13.180 | 11.488 | 24.669 |
| height | -2.858 | 2.389 | 5.247 |

instruments used:

instrument type: VZ-400i

serial number: H2227243



Map Data © OpenStreetMap contributors

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 | Ref. Scans |
|------------|------------|----------|---------------------|----------------------|----------------|----------------|---------------|
| ScanPos001 | 2024-09-21 | 22:54:05 | 359.78 | 30.0 | 42,933,714 | 0 | 0 |
| ScanPos002 | 2024-09-21 | 22:55:50 | 359.86 | 30.0 | 39,621,710 | 0 | 0 |
| ScanPos003 | 2024-09-21 | 22:59:48 | 359.87 | 30.0 | 43,001,165 | 0 | 0 |
| ScanPos004 | 2024-09-21 | 23:03:20 | 359.99 | 30.0 | 39,021,539 | 0 | 0 |
| ScanPos005 | 2024-09-21 | 23:07:47 | 359.82 | 30.0 | 42,734,535 | 0 | 0 |

| Name | Date | Time | Horiz. FoV [deg] | Resolution [mdeg] | Point Count | Image Count | Refl. Scans |
|------------|------------|----------|---------------------|----------------------|----------------|----------------|----------------|
| ScanPos006 | 2024-09-21 | 23:09:47 | 359.95 | 30.0 | 40,310,498 | 0 | 0 |
| ScanPos007 | 2024-09-21 | 23:14:19 | 359.84 | 30.0 | 42,692,161 | 0 | 0 |
| ScanPos008 | 2024-09-21 | 23:16:14 | 359.91 | 30.0 | 39,048,374 | 0 | 0 |
| ScanPos009 | 2024-09-21 | 23:19:47 | 359.86 | 30.0 | 41,993,385 | 0 | 0 |
| ScanPos010 | 2024-09-21 | 23:23:27 | 359.99 | 30.0 | 39,762,562 | 0 | 0 |
| ScanPos011 | 2024-09-21 | 23:29:32 | 359.82 | 30.0 | 43,198,174 | 0 | 0 |
| ScanPos012 | 2024-09-21 | 23:31:32 | 359.81 | 30.0 | 39,752,310 | 0 | 0 |
| ScanPos013 | 2024-09-21 | 23:35:47 | 359.71 | 30.0 | 42,451,393 | 0 | 0 |
| ScanPos014 | 2024-09-21 | 23:37:37 | 360.00 | 30.0 | 40,112,547 | 0 | 0 |
| ScanPos015 | 2024-09-21 | 23:41:08 | 359.94 | 30.0 | 42,881,931 | 0 | 0 |
| ScanPos016 | 2024-09-21 | 23:42:59 | 360.00 | 30.0 | 38,581,807 | 0 | 0 |
| ScanPos017 | 2024-09-21 | 23:47:13 | 359.89 | 30.0 | 40,228,550 | 0 | 0 |
| ScanPos018 | 2024-09-21 | 23:48:58 | 359.98 | 30.0 | 36,393,805 | 0 | 0 |
| ScanPos019 | 2024-09-21 | 23:52:47 | 359.76 | 30.0 | 39,370,241 | 0 | 0 |
| ScanPos020 | 2024-09-21 | 23:54:58 | 359.83 | 30.0 | 36,428,901 | 0 | 0 |
| ScanPos021 | 2024-09-21 | 23:59:25 | 359.86 | 30.0 | 37,634,006 | 0 | 0 |
| ScanPos022 | 2024-09-22 | 00:01:59 | 359.98 | 30.0 | 35,898,237 | 0 | 0 |
| ScanPos023 | 2024-09-22 | 00:06:36 | 359.84 | 30.0 | 40,558,254 | 0 | 0 |
| ScanPos024 | 2024-09-22 | 00:08:47 | 359.98 | 30.0 | 35,553,390 | 0 | 0 |
| ScanPos025 | 2024-09-22 | 00:14:25 | 359.87 | 30.0 | 40,904,893 | 0 | 0 |
| ScanPos026 | 2024-09-22 | 00:16:33 | 359.86 | 30.0 | 36,807,345 | 0 | 0 |
| ScanPos027 | 2024-09-22 | 00:22:06 | 359.64 | 30.0 | 39,715,143 | 0 | 0 |
| ScanPos028 | 2024-09-22 | 00:25:38 | 359.83 | 30.0 | 37,587,517 | 0 | 0 |
| ScanPos029 | 2024-09-22 | 00:29:39 | 359.88 | 30.0 | 39,791,156 | 0 | 0 |
| ScanPos030 | 2024-09-22 | 00:31:35 | 359.98 | 30.0 | 37,351,843 | 0 | 0 |
| ScanPos031 | 2024-09-22 | 00:35:21 | 359.75 | 30.0 | 38,470,067 | 0 | 0 |
| ScanPos032 | 2024-09-22 | 00:37:13 | 359.96 | 30.0 | 35,546,780 | 0 | 0 |
| ScanPos033 | 2024-09-22 | 00:42:15 | 359.82 | 30.0 | 41,067,411 | 0 | 0 |
| ScanPos034 | 2024-09-22 | 00:44:12 | 359.99 | 30.0 | 36,322,499 | 0 | 0 |
| ScanPos035 | 2024-09-22 | 00:48:13 | 359.75 | 30.0 | 40,189,510 | 0 | 0 |
| ScanPos036 | 2024-09-22 | 00:50:00 | 359.82 | 30.0 | 36,043,741 | 0 | 0 |
| ScanPos037 | 2024-09-22 | 00:54:27 | 359.82 | 30.0 | 41,367,331 | 0 | 0 |
| ScanPos038 | 2024-09-22 | 00:56:19 | 360.00 | 30.0 | 36,607,118 | 0 | 0 |
| ScanPos039 | 2024-09-22 | 01:00:03 | 359.65 | 30.0 | 40,951,393 | 0 | 0 |
| ScanPos040 | 2024-09-22 | 01:02:18 | 359.92 | 30.0 | 37,363,782 | 0 | 0 |
| ScanPos041 | 2024-09-22 | 01:07:22 | 359.87 | 30.0 | 41,809,177 | 0 | 0 |
| ScanPos042 | 2024-09-22 | 01:09:41 | 360.00 | 30.0 | 37,969,911 | 0 | 0 |
| Total | | | | | 1,656,029,806 | | |

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 | -7.857 | -1.366 | -1.078 | 0.020 | 0.020 | 1.000 | dynamic |
| ScanPos002 | -107.279 | -57.438 | 86.183 | 0.135 | 0.135 | 1.000 | dynamic |
| ScanPos003 | 7.110 | -4.115 | -112.624 | 0.020 | 0.020 | 1.000 | dynamic |
| ScanPos004 | 164.766 | -81.432 | 67.773 | 0.137 | 0.137 | 1.000 | dynamic |
| ScanPos005 | -6.809 | -3.714 | -109.715 | 0.019 | 0.019 | 1.000 | dynamic |
| ScanPos006 | 96.215 | -44.854 | -144.871 | 0.143 | 0.143 | 1.000 | dynamic |
| ScanPos007 | -0.661 | 11.599 | 70.510 | 0.025 | 0.025 | 1.000 | dynamic |
| ScanPos008 | 65.528 | -68.270 | 20.941 | 0.136 | 0.136 | 1.000 | dynamic |
| ScanPos009 | 1.262 | 5.116 | 130.766 | 0.015 | 0.015 | 1.000 | dynamic |
| ScanPos010 | -54.012 | -82.018 | 174.547 | 0.143 | 0.143 | 1.000 | dynamic |
| ScanPos011 | -8.017 | -4.418 | -116.368 | 0.022 | 0.022 | 1.000 | dynamic |
| ScanPos012 | -99.704 | 26.776 | -159.051 | 0.136 | 0.136 | 1.000 | dynamic |
| ScanPos013 | -2.680 | 1.904 | -3.123 | 0.012 | 0.012 | 1.000 | dynamic |
| ScanPos014 | -172.558 | 84.174 | 174.347 | 0.141 | 0.141 | 1.000 | dynamic |
| ScanPos015 | 4.803 | 2.761 | 160.939 | 0.016 | 0.016 | 1.000 | dynamic |
| ScanPos016 | 112.586 | -77.689 | 49.157 | 0.143 | 0.143 | 1.000 | dynamic |
| ScanPos017 | 5.000 | 6.229 | 115.583 | 0.020 | 0.020 | 1.000 | dynamic |
| ScanPos018 | 39.131 | -83.240 | 73.088 | 0.142 | 0.142 | 1.000 | dynamic |
| ScanPos019 | -7.126 | -5.473 | -7.573 | 0.021 | 0.021 | 1.000 | dynamic |
| ScanPos020 | -123.153 | -69.025 | 107.746 | 0.132 | 0.132 | 1.000 | dynamic |
| ScanPos021 | -6.725 | 6.577 | -55.146 | 0.022 | 0.022 | 1.000 | dynamic |
| ScanPos022 | 142.054 | -78.564 | 143.261 | 0.136 | 0.136 | 1.000 | dynamic |
| ScanPos023 | 6.052 | -3.239 | 171.381 | 0.018 | 0.018 | 1.000 | dynamic |
| ScanPos024 | -82.715 | 41.292 | 140.791 | 0.141 | 0.141 | 1.000 | dynamic |
| ScanPos025 | 4.285 | -5.435 | 178.978 | 0.018 | 0.018 | 1.000 | dynamic |
| ScanPos026 | 76.279 | 69.891 | -107.459 | 0.143 | 0.143 | 1.000 | dynamic |
| ScanPos027 | -0.378 | -2.808 | -172.176 | 0.012 | 0.012 | 1.000 | dynamic |
| ScanPos028 | -95.946 | -2.963 | -172.608 | 0.141 | 0.141 | 1.000 | dynamic |
| ScanPos029 | -5.323 | 1.229 | -10.258 | 0.016 | 0.016 | 1.000 | dynamic |
| ScanPos030 | 84.279 | 10.228 | -3.249 | 0.141 | 0.141 | 1.000 | dynamic |
| ScanPos031 | -2.900 | -1.231 | -81.086 | 0.012 | 0.012 | 1.000 | dynamic |
| ScanPos032 | 102.946 | 69.542 | -0.713 | 0.143 | 0.143 | 1.000 | dynamic |
| ScanPos033 | -2.273 | -4.321 | -101.579 | 0.015 | 0.015 | 1.000 | dynamic |
| ScanPos034 | -132.115 | -75.998 | 14.343 | 0.135 | 0.135 | 1.000 | dynamic |
| ScanPos035 | -8.458 | -2.345 | -84.409 | 0.021 | 0.021 | 1.000 | dynamic |

| Name | Roll | Pitch | Yaw | Acc. Roll | Acc. Pitch | Acc. Yaw | PoseEstimation Type |
|------------|----------|---------|----------|-----------|------------|----------|---------------------|
| ScanPos036 | -120.530 | -74.132 | 29.869 | 0.137 | 0.137 | 1.000 | dynamic |
| ScanPos037 | 0.389 | 4.250 | 122.862 | 0.014 | 0.014 | 1.000 | dynamic |
| ScanPos038 | -18.567 | -85.252 | 136.476 | 0.143 | 0.143 | 1.000 | dynamic |
| ScanPos039 | -0.344 | 2.147 | -40.861 | 0.010 | 0.010 | 1.000 | dynamic |
| ScanPos040 | 108.406 | 68.602 | 42.205 | 0.139 | 0.139 | 1.000 | dynamic |
| ScanPos041 | -1.892 | -4.573 | -150.895 | 0.015 | 0.015 | 1.000 | dynamic |
| ScanPos042 | 84.340 | 30.805 | -110.474 | 0.142 | 0.142 | 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 | 16,668 | 3,728 | 4,010 | 630 | 684 | 691 |
| ScanPos002 | 12,404 | 2,946 | 3,136 | 589 | 516 | 463 |
| ScanPos003 | 13,562 | 3,020 | 3,196 | 463 | 498 | 637 |
| ScanPos004 | 9,718 | 1,978 | 2,124 | 248 | 336 | 478 |
| ScanPos005 | 12,246 | 2,876 | 3,006 | 469 | 486 | 548 |
| ScanPos006 | 8,388 | 1,848 | 1,924 | 321 | 304 | 337 |
| ScanPos007 | 14,818 | 3,338 | 3,500 | 545 | 568 | 637 |
| ScanPos008 | 10,750 | 2,364 | 2,458 | 305 | 412 | 512 |
| ScanPos009 | 11,352 | 2,456 | 2,566 | 418 | 411 | 454 |
| ScanPos010 | 7,876 | 1,682 | 1,774 | 250 | 295 | 342 |
| ScanPos011 | 13,524 | 2,978 | 3,140 | 469 | 561 | 540 |
| ScanPos012 | 11,616 | 2,578 | 2,684 | 406 | 424 | 512 |
| ScanPos013 | 17,744 | 4,280 | 4,492 | 783 | 708 | 755 |
| ScanPos014 | 15,560 | 3,804 | 4,000 | 687 | 635 | 678 |
| ScanPos015 | 20,892 | 5,028 | 5,232 | 905 | 833 | 878 |

| Name | Number of Plane Patches | | | Plane Patches of Phase 3 | | |
|------------|-------------------------|---------|---------|--------------------------|-----|--------|
| | Phase 1 | Phase 2 | Phase 3 | NS | WE | Horiz. |
| ScanPos016 | 18,772 | 4,788 | 4,994 | 858 | 751 | 888 |
| ScanPos017 | 17,986 | 4,446 | 4,648 | 758 | 826 | 740 |
| ScanPos018 | 15,294 | 3,816 | 4,056 | 697 | 702 | 629 |
| ScanPos019 | 16,710 | 4,176 | 4,412 | 725 | 813 | 668 |
| ScanPos020 | 11,500 | 2,726 | 2,828 | 483 | 462 | 469 |
| ScanPos021 | 11,074 | 2,704 | 2,852 | 447 | 524 | 455 |
| ScanPos022 | 10,304 | 2,630 | 2,742 | 434 | 500 | 437 |
| ScanPos023 | 11,632 | 2,918 | 3,050 | 404 | 660 | 461 |
| ScanPos024 | 5,212 | 1,262 | 1,332 | 197 | 278 | 191 |
| ScanPos025 | 9,122 | 2,128 | 2,236 | 347 | 399 | 372 |
| ScanPos026 | 6,984 | 1,568 | 1,646 | 294 | 243 | 286 |
| ScanPos027 | 13,444 | 3,394 | 3,584 | 502 | 663 | 627 |
| ScanPos028 | 9,238 | 2,372 | 2,526 | 439 | 486 | 338 |
| ScanPos029 | 10,002 | 2,332 | 2,450 | 381 | 444 | 400 |
| ScanPos030 | 9,364 | 2,354 | 2,472 | 368 | 494 | 374 |
| ScanPos031 | 6,362 | 1,394 | 1,438 | 187 | 223 | 309 |
| ScanPos032 | 4,930 | 1,102 | 1,142 | 137 | 168 | 266 |
| ScanPos033 | 7,766 | 1,668 | 1,722 | 250 | 231 | 380 |
| ScanPos034 | 4,788 | 964 | 996 | 180 | 109 | 209 |
| ScanPos035 | 5,710 | 1,186 | 1,220 | 177 | 142 | 291 |
| ScanPos036 | 2,292 | 444 | 446 | 34 | 28 | 161 |
| ScanPos037 | 11,040 | 2,266 | 2,366 | 344 | 362 | 477 |
| ScanPos038 | 9,260 | 2,150 | 2,212 | 346 | 380 | 380 |
| ScanPos039 | 7,780 | 1,554 | 1,614 | 287 | 264 | 256 |
| ScanPos040 | 8,542 | 1,948 | 1,976 | 379 | 296 | 313 |
| ScanPos041 | 10,956 | 2,548 | 2,620 | 388 | 449 | 473 |
| ScanPos042 | 8,480 | 1,850 | 1,878 | 302 | 266 | 371 |

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: 24,319
scan position plane patches: 56,350
GNSS measurements: 0
orientation measurements: 42
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: 2024-11-24T11:55:06
run time: 00:11:22
parameters estimated: 73,207

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 | 1.967 | 2.496 | 0.125 | 0.000 | 0.000 | 0.000 |
| ScanPos002 | 1.725 | 2.583 | -0.190 | 0.000 | 0.000 | 0.000 |
| ScanPos003 | 0.150 | 6.386 | -1.014 | 0.000 | 0.000 | 0.000 |
| ScanPos004 | 0.308 | 6.595 | -1.325 | 0.000 | 0.000 | 0.000 |
| ScanPos005 | 5.534 | 11.260 | -2.578 | 0.000 | 0.000 | 0.000 |
| ScanPos006 | 5.343 | 11.488 | -2.858 | 0.000 | 0.000 | 0.000 |
| ScanPos007 | 5.862 | 7.188 | -2.087 | 0.000 | 0.000 | 0.000 |
| ScanPos008 | 5.838 | 6.857 | -2.323 | 0.000 | 0.000 | 0.000 |
| ScanPos009 | 10.496 | 7.209 | -2.506 | 0.000 | 0.000 | 0.000 |
| ScanPos010 | 10.669 | 6.955 | -2.777 | 0.000 | 0.000 | 0.000 |

| Name | X [m] | Y [m] | Z [m] | Acc. X [m] | Acc. Y [m] | Acc. Z [m] |
|------------|---------|---------|--------|------------|------------|------------|
| ScanPos011 | 6.953 | 3.863 | -1.269 | 0.000 | 0.000 | 0.000 |
| ScanPos012 | 7.043 | 3.615 | -1.580 | 0.000 | 0.000 | 0.000 |
| ScanPos013 | 5.060 | 1.145 | 0.030 | 0.000 | 0.000 | 0.000 |
| ScanPos014 | 5.328 | 1.106 | -0.266 | 0.000 | 0.000 | 0.000 |
| ScanPos015 | 3.189 | -1.213 | 0.816 | 0.000 | 0.000 | 0.000 |
| ScanPos016 | 3.468 | -1.297 | 0.530 | 0.000 | 0.000 | 0.000 |
| ScanPos017 | -1.188 | -5.377 | 1.064 | 0.000 | 0.000 | 0.000 |
| ScanPos018 | -1.078 | -5.667 | 0.802 | 0.000 | 0.000 | 0.000 |
| ScanPos019 | -5.178 | -7.373 | 0.931 | 0.000 | 0.000 | 0.000 |
| ScanPos020 | -5.413 | -7.313 | 0.605 | 0.000 | 0.000 | 0.000 |
| ScanPos021 | -9.239 | -7.321 | 0.509 | 0.000 | 0.000 | 0.000 |
| ScanPos022 | -8.583 | -7.392 | 0.081 | 0.000 | 0.000 | 0.000 |
| ScanPos023 | -8.840 | -11.697 | 1.431 | 0.000 | 0.000 | 0.000 |
| ScanPos024 | -9.065 | -11.915 | 1.171 | 0.000 | 0.000 | 0.000 |
| ScanPos025 | -11.244 | -13.180 | 2.022 | 0.000 | 0.000 | 0.000 |
| ScanPos026 | -11.540 | -13.138 | 1.754 | 0.000 | 0.000 | 0.000 |
| ScanPos027 | -11.963 | -9.399 | 1.597 | 0.000 | 0.000 | 0.000 |
| ScanPos028 | -11.932 | -9.676 | 1.299 | 0.000 | 0.000 | 0.000 |
| ScanPos029 | -12.069 | -6.916 | 1.255 | 0.000 | 0.000 | 0.000 |
| ScanPos030 | -12.091 | -7.218 | 0.995 | 0.000 | 0.000 | 0.000 |
| ScanPos031 | -11.835 | -4.916 | 0.908 | 0.000 | 0.000 | 0.000 |
| ScanPos032 | -11.912 | -5.197 | 0.627 | 0.000 | 0.000 | 0.000 |
| ScanPos033 | -16.695 | -4.550 | 2.005 | 0.000 | 0.000 | 0.000 |
| ScanPos034 | -16.612 | -4.309 | 1.688 | 0.000 | 0.000 | 0.000 |
| ScanPos035 | -16.678 | -2.234 | 1.587 | 0.000 | 0.000 | 0.000 |
| ScanPos036 | -16.720 | -1.972 | 1.278 | 0.000 | 0.000 | 0.000 |
| ScanPos037 | -16.716 | -8.313 | 2.304 | 0.000 | 0.000 | 0.000 |
| ScanPos038 | -16.560 | -8.571 | 2.031 | 0.000 | 0.000 | 0.000 |
| ScanPos039 | -18.477 | -7.815 | 2.389 | 0.000 | 0.000 | 0.000 |
| ScanPos040 | -18.354 | -8.058 | 2.079 | 0.000 | 0.000 | 0.000 |
| ScanPos041 | -13.815 | -10.773 | 2.105 | 0.000 | 0.000 | 0.000 |
| ScanPos042 | -14.089 | -10.652 | 1.838 | 0.000 | 0.000 | 0.000 |

| Name | Roll [deg] | Pitch [deg] | Yaw [deg] | Acc. Roll [deg] | Acc. Pitch [deg] | Acc. Yaw [deg] |
|------------|------------|-------------|-----------|-----------------|------------------|----------------|
| ScanPos001 | -7.876 | -1.368 | -2.059 | 0.019 | 0.019 | 0.001 |
| ScanPos002 | -105.256 | -57.728 | 76.283 | 0.019 | 0.019 | 0.002 |
| ScanPos003 | 7.117 | -4.128 | -113.570 | 0.019 | 0.019 | 0.001 |
| ScanPos004 | 161.978 | -82.658 | 78.830 | 0.021 | 0.019 | 0.010 |
| ScanPos005 | -6.838 | -3.726 | -108.550 | 0.019 | 0.019 | 0.001 |
| ScanPos006 | 90.712 | -45.020 | -147.141 | 0.019 | 0.019 | 0.002 |
| ScanPos007 | -0.661 | 11.633 | 71.090 | 0.019 | 0.019 | 0.001 |
| ScanPos008 | 68.568 | -68.692 | 18.545 | 0.019 | 0.019 | 0.004 |

| Name | Roll [deg] | Pitch [deg] | Yaw [deg] | Acc. Roll [deg] | Acc. Pitch [deg] | Acc. Yaw [deg] |
|------------|------------|-------------|-----------|-----------------|------------------|----------------|
| ScanPos009 | 1.265 | 5.131 | 131.238 | 0.019 | 0.019 | 0.001 |
| ScanPos010 | -76.982 | -83.382 | -159.142 | 0.025 | 0.019 | 0.016 |
| ScanPos011 | -8.051 | -4.432 | -115.087 | 0.019 | 0.019 | 0.001 |
| ScanPos012 | -98.322 | 26.842 | -155.116 | 0.019 | 0.019 | 0.001 |
| ScanPos013 | -2.690 | 1.907 | -3.533 | 0.019 | 0.019 | 0.001 |
| ScanPos014 | -168.010 | 86.297 | -173.483 | 0.023 | 0.019 | 0.013 |
| ScanPos015 | 4.815 | 2.769 | 161.708 | 0.019 | 0.019 | 0.001 |
| ScanPos016 | 97.928 | -78.486 | 70.221 | 0.020 | 0.019 | 0.005 |
| ScanPos017 | 5.010 | 6.247 | 116.286 | 0.019 | 0.019 | 0.001 |
| ScanPos018 | 56.859 | -84.876 | 58.330 | 0.023 | 0.019 | 0.013 |
| ScanPos019 | -7.155 | -5.493 | -9.196 | 0.019 | 0.019 | 0.001 |
| ScanPos020 | -120.936 | -69.499 | 98.127 | 0.019 | 0.019 | 0.003 |
| ScanPos021 | -6.753 | 6.590 | -54.707 | 0.019 | 0.019 | 0.001 |
| ScanPos022 | 137.925 | -79.454 | 144.867 | 0.020 | 0.019 | 0.007 |
| ScanPos023 | 6.067 | -3.250 | 172.805 | 0.019 | 0.019 | 0.001 |
| ScanPos024 | -85.874 | 41.433 | 135.585 | 0.019 | 0.019 | 0.003 |
| ScanPos025 | 4.289 | -5.450 | -179.269 | 0.019 | 0.019 | 0.001 |
| ScanPos026 | 85.120 | 70.370 | -107.740 | 0.020 | 0.019 | 0.005 |
| ScanPos027 | -0.384 | -2.814 | -171.276 | 0.019 | 0.019 | 0.001 |
| ScanPos028 | -94.034 | -2.991 | -170.951 | 0.019 | 0.019 | 0.001 |
| ScanPos029 | -5.336 | 1.227 | -10.541 | 0.019 | 0.019 | 0.001 |
| ScanPos030 | 86.459 | 10.261 | -2.951 | 0.019 | 0.019 | 0.001 |
| ScanPos031 | -2.919 | -1.240 | -81.197 | 0.019 | 0.019 | 0.001 |
| ScanPos032 | 91.676 | 70.031 | -11.752 | 0.020 | 0.019 | 0.006 |
| ScanPos033 | -2.276 | -4.338 | -101.404 | 0.019 | 0.019 | 0.001 |
| ScanPos034 | -128.510 | -76.741 | 17.227 | 0.022 | 0.019 | 0.010 |
| ScanPos035 | -8.479 | -2.349 | -83.840 | 0.019 | 0.019 | 0.002 |
| ScanPos036 | -116.144 | -74.772 | 26.214 | 0.022 | 0.019 | 0.010 |
| ScanPos037 | 0.375 | 4.270 | 123.252 | 0.019 | 0.019 | 0.001 |
| ScanPos038 | -66.013 | -88.360 | -172.649 | 0.067 | 0.019 | 0.064 |
| ScanPos039 | -0.272 | 2.137 | -41.463 | 0.019 | 0.019 | 0.002 |
| ScanPos040 | 104.028 | 69.045 | 40.251 | 0.020 | 0.019 | 0.005 |
| ScanPos041 | -1.904 | -4.589 | -149.860 | 0.019 | 0.019 | 0.001 |
| ScanPos042 | 87.464 | 30.926 | -117.469 | 0.019 | 0.019 | 0.002 |

In the coordinate reference system:

| Name | Easting [m] | Northing [m] | Height [m] | Acc. East [m] | Acc. North [m] | Acc. Up [m] |
|------------|-------------|--------------|------------|---------------|----------------|-------------|
| ScanPos001 | 866705.3745 | 328936.4987 | 126.4424 | 0.000 | 0.000 | 0.000 |
| ScanPos002 | 866705.1321 | 328936.5848 | 126.1275 | 0.000 | 0.000 | 0.000 |
| ScanPos003 | 866703.5433 | 328940.3885 | 125.3032 | 0.000 | 0.000 | 0.000 |
| ScanPos004 | 866703.7007 | 328940.5979 | 124.9921 | 0.000 | 0.000 | 0.000 |

| Name | Easting [m] | Northing [m] | Height [m] | Acc. East [m] | Acc. North [m] | Acc. Up [m] |
|------------|-------------|--------------|------------|---------------|----------------|-------------|
| ScanPos005 | 866708.9195 | 328945.2843 | 123.7391 | 0.000 | 0.000 | 0.000 |
| ScanPos006 | 866708.7275 | 328945.5122 | 123.4597 | 0.000 | 0.000 | 0.000 |
| ScanPos007 | 866709.2597 | 328941.2078 | 124.2306 | 0.000 | 0.000 | 0.000 |
| ScanPos008 | 866709.2374 | 328940.8765 | 123.9945 | 0.000 | 0.000 | 0.000 |
| ScanPos009 | 866713.8998 | 328941.2427 | 123.8110 | 0.000 | 0.000 | 0.000 |
| ScanPos010 | 866714.0739 | 328940.9897 | 123.5404 | 0.000 | 0.000 | 0.000 |
| ScanPos011 | 866710.3621 | 328937.8826 | 125.0485 | 0.000 | 0.000 | 0.000 |
| ScanPos012 | 866710.4535 | 328937.6346 | 124.7377 | 0.000 | 0.000 | 0.000 |
| ScanPos013 | 866708.4754 | 328935.1553 | 126.3472 | 0.000 | 0.000 | 0.000 |
| ScanPos014 | 866708.7441 | 328935.1174 | 126.0515 | 0.000 | 0.000 | 0.000 |
| ScanPos015 | 866706.6089 | 328932.7886 | 127.1336 | 0.000 | 0.000 | 0.000 |
| ScanPos016 | 866706.8883 | 328932.7057 | 126.8474 | 0.000 | 0.000 | 0.000 |
| ScanPos017 | 866702.2390 | 328928.6062 | 127.3817 | 0.000 | 0.000 | 0.000 |
| ScanPos018 | 866702.3499 | 328928.3162 | 127.1197 | 0.000 | 0.000 | 0.000 |
| ScanPos019 | 866698.2502 | 328926.5965 | 127.2479 | 0.000 | 0.000 | 0.000 |
| ScanPos020 | 866698.0145 | 328926.6558 | 126.9227 | 0.000 | 0.000 | 0.000 |
| ScanPos021 | 866694.1839 | 328926.6364 | 126.8265 | 0.000 | 0.000 | 0.000 |
| ScanPos022 | 866694.8407 | 328926.5666 | 126.3980 | 0.000 | 0.000 | 0.000 |
| ScanPos023 | 866694.5962 | 328922.2558 | 127.7482 | 0.000 | 0.000 | 0.000 |
| ScanPos024 | 866694.3713 | 328922.0364 | 127.4880 | 0.000 | 0.000 | 0.000 |
| ScanPos025 | 866692.1936 | 328920.7634 | 128.3394 | 0.000 | 0.000 | 0.000 |
| ScanPos026 | 866691.8973 | 328920.8050 | 128.0709 | 0.000 | 0.000 | 0.000 |
| ScanPos027 | 866691.4625 | 328924.5469 | 127.9143 | 0.000 | 0.000 | 0.000 |
| ScanPos028 | 866691.4948 | 328924.2704 | 127.6159 | 0.000 | 0.000 | 0.000 |
| ScanPos029 | 866691.3490 | 328927.0332 | 127.5720 | 0.000 | 0.000 | 0.000 |
| ScanPos030 | 866691.3284 | 328926.7303 | 127.3122 | 0.000 | 0.000 | 0.000 |
| ScanPos031 | 866691.5778 | 328929.0361 | 127.2252 | 0.000 | 0.000 | 0.000 |
| ScanPos032 | 866691.5008 | 328928.7545 | 126.9440 | 0.000 | 0.000 | 0.000 |
| ScanPos033 | 866686.7101 | 328929.3877 | 128.3222 | 0.000 | 0.000 | 0.000 |
| ScanPos034 | 866686.7926 | 328929.6297 | 128.0048 | 0.000 | 0.000 | 0.000 |
| ScanPos035 | 866686.7206 | 328931.7075 | 127.9041 | 0.000 | 0.000 | 0.000 |
| ScanPos036 | 866686.6777 | 328931.9693 | 127.5954 | 0.000 | 0.000 | 0.000 |
| ScanPos037 | 866686.7008 | 328925.6203 | 128.6213 | 0.000 | 0.000 | 0.000 |
| ScanPos038 | 866686.8572 | 328925.3630 | 128.3481 | 0.000 | 0.000 | 0.000 |
| ScanPos039 | 866684.9353 | 328926.1138 | 128.7064 | 0.000 | 0.000 | 0.000 |
| ScanPos040 | 866685.0597 | 328925.8704 | 128.3961 | 0.000 | 0.000 | 0.000 |
| ScanPos041 | 866689.6120 | 328923.1661 | 128.4222 | 0.000 | 0.000 | 0.000 |
| ScanPos042 | 866689.3375 | 328923.2865 | 128.1553 | 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:

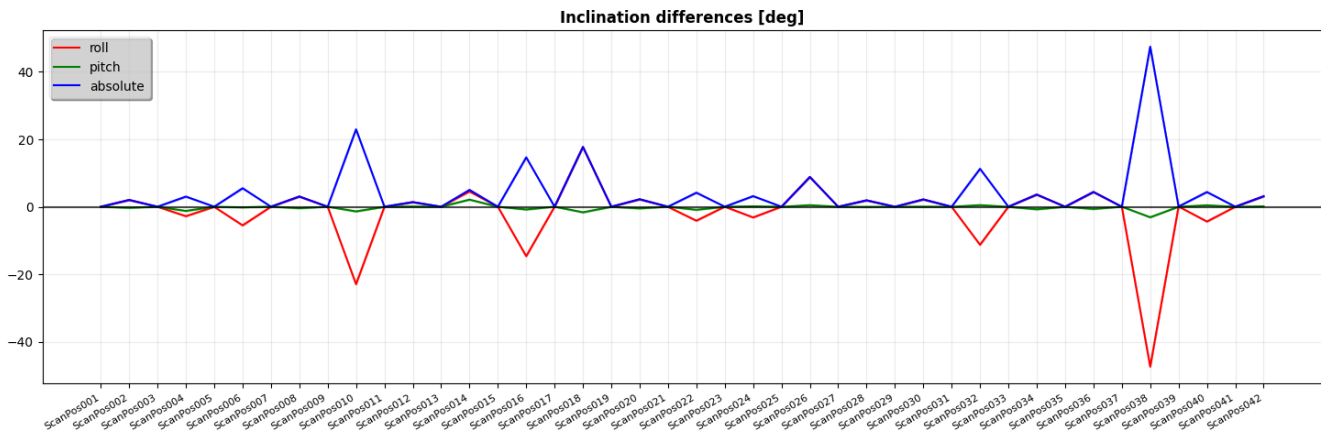
| Name | Changes wrt to prior to multi-station adjustment | | | | | |
|------------|--|---------|---------|------------|-------------|-----------|
| | X [m] | Y [m] | Z [m] | Roll [deg] | Pitch [deg] | Yaw [deg] |
| ScanPos001 | -0.0000 | 0.0000 | -0.0003 | -0.0083 | 0.0017 | -0.0231 |
| ScanPos002 | -0.0003 | 0.0004 | -0.0022 | 0.0069 | 0.0003 | -0.0322 |
| ScanPos003 | 0.0002 | 0.0021 | -0.0011 | 0.0085 | -0.0033 | -0.0223 |
| ScanPos004 | -0.0001 | 0.0032 | -0.0012 | -0.0294 | 0.0097 | 0.0093 |
| ScanPos005 | 0.0021 | 0.0012 | -0.0013 | 0.0029 | -0.0014 | -0.0209 |
| ScanPos006 | 0.0017 | 0.0002 | -0.0006 | 0.0190 | -0.0073 | -0.0370 |
| ScanPos007 | 0.0017 | 0.0000 | -0.0014 | 0.0006 | 0.0008 | -0.0233 |
| ScanPos008 | 0.0022 | 0.0001 | -0.0021 | 0.0003 | 0.0003 | -0.0272 |
| ScanPos009 | 0.0019 | -0.0020 | -0.0021 | 0.0064 | 0.0016 | -0.0240 |
| ScanPos010 | 0.0019 | -0.0030 | -0.0020 | 0.1003 | 0.0012 | -0.1219 |
| ScanPos011 | 0.0011 | -0.0031 | -0.0015 | 0.0021 | -0.0018 | -0.0226 |
| ScanPos012 | 0.0002 | -0.0007 | -0.0017 | 0.0056 | 0.0019 | -0.0207 |
| ScanPos013 | -0.0008 | -0.0001 | -0.0007 | -0.0029 | 0.0002 | -0.0243 |
| ScanPos014 | -0.0008 | 0.0004 | -0.0009 | 0.0130 | 0.0006 | -0.0103 |
| ScanPos015 | -0.0023 | 0.0010 | -0.0008 | 0.0024 | 0.0028 | -0.0223 |
| ScanPos016 | -0.0024 | 0.0010 | -0.0006 | -0.0076 | -0.0003 | -0.0164 |
| ScanPos017 | -0.0038 | 0.0028 | -0.0008 | -0.0014 | 0.0010 | -0.0236 |
| ScanPos018 | -0.0043 | 0.0033 | -0.0011 | -0.0497 | 0.0012 | 0.0267 |
| ScanPos019 | -0.0043 | 0.0046 | -0.0008 | -0.0053 | -0.0066 | -0.0214 |
| ScanPos020 | -0.0043 | 0.0055 | -0.0013 | -0.0051 | 0.0050 | -0.0175 |
| ScanPos021 | -0.0038 | 0.0058 | -0.0004 | 0.0057 | -0.0061 | -0.0216 |
| ScanPos022 | -0.0041 | 0.0053 | -0.0009 | -0.0016 | 0.0074 | -0.0210 |
| ScanPos023 | -0.0065 | 0.0065 | -0.0009 | -0.0060 | 0.0058 | -0.0252 |
| ScanPos024 | -0.0062 | 0.0074 | -0.0009 | -0.0038 | 0.0000 | -0.0265 |
| ScanPos025 | -0.0060 | 0.0067 | -0.0009 | 0.0045 | -0.0001 | -0.0215 |
| ScanPos026 | -0.0075 | 0.0071 | -0.0005 | 0.0796 | -0.0002 | 0.0592 |
| ScanPos027 | -0.0052 | 0.0068 | -0.0010 | 0.0019 | 0.0099 | -0.0220 |
| ScanPos028 | -0.0055 | 0.0064 | -0.0008 | 0.0178 | 0.0129 | -0.0187 |
| ScanPos029 | -0.0027 | 0.0089 | -0.0017 | -0.0048 | -0.0141 | -0.0279 |
| ScanPos030 | -0.0034 | 0.0072 | -0.0015 | -0.0133 | -0.0066 | -0.0344 |
| ScanPos031 | -0.0037 | 0.0066 | -0.0014 | 0.0085 | -0.0038 | -0.0234 |
| ScanPos032 | -0.0036 | 0.0069 | -0.0016 | -0.0093 | -0.0161 | -0.0349 |
| ScanPos033 | -0.0028 | 0.0090 | -0.0018 | 0.0133 | 0.0018 | -0.0271 |
| ScanPos034 | -0.0031 | 0.0091 | -0.0021 | -0.0743 | -0.0047 | 0.0436 |
| ScanPos035 | -0.0016 | 0.0098 | -0.0024 | 0.0164 | -0.0117 | -0.0239 |

| Changes wrt to prior to multi-station adjustment | | | | | | |
|--|---------|--------|---------|------------|-------------|-----------|
| Name | X [m] | Y [m] | Z [m] | Roll [deg] | Pitch [deg] | Yaw [deg] |
| ScanPos036 | -0.0013 | 0.0099 | -0.0026 | -0.0370 | -0.0091 | 0.0123 |
| ScanPos037 | -0.0045 | 0.0102 | -0.0027 | -0.0043 | 0.0075 | -0.0256 |
| ScanPos038 | -0.0050 | 0.0098 | -0.0022 | -0.4732 | 0.0105 | 0.4526 |
| ScanPos039 | -0.0076 | 0.0093 | -0.0022 | -0.0074 | -0.0105 | -0.0212 |
| ScanPos040 | -0.0049 | 0.0103 | -0.0027 | -0.0311 | -0.0049 | -0.0504 |
| ScanPos041 | -0.0060 | 0.0089 | -0.0020 | 0.0048 | 0.0130 | -0.0196 |
| ScanPos042 | -0.0059 | 0.0085 | -0.0019 | 0.0158 | 0.0062 | -0.0054 |

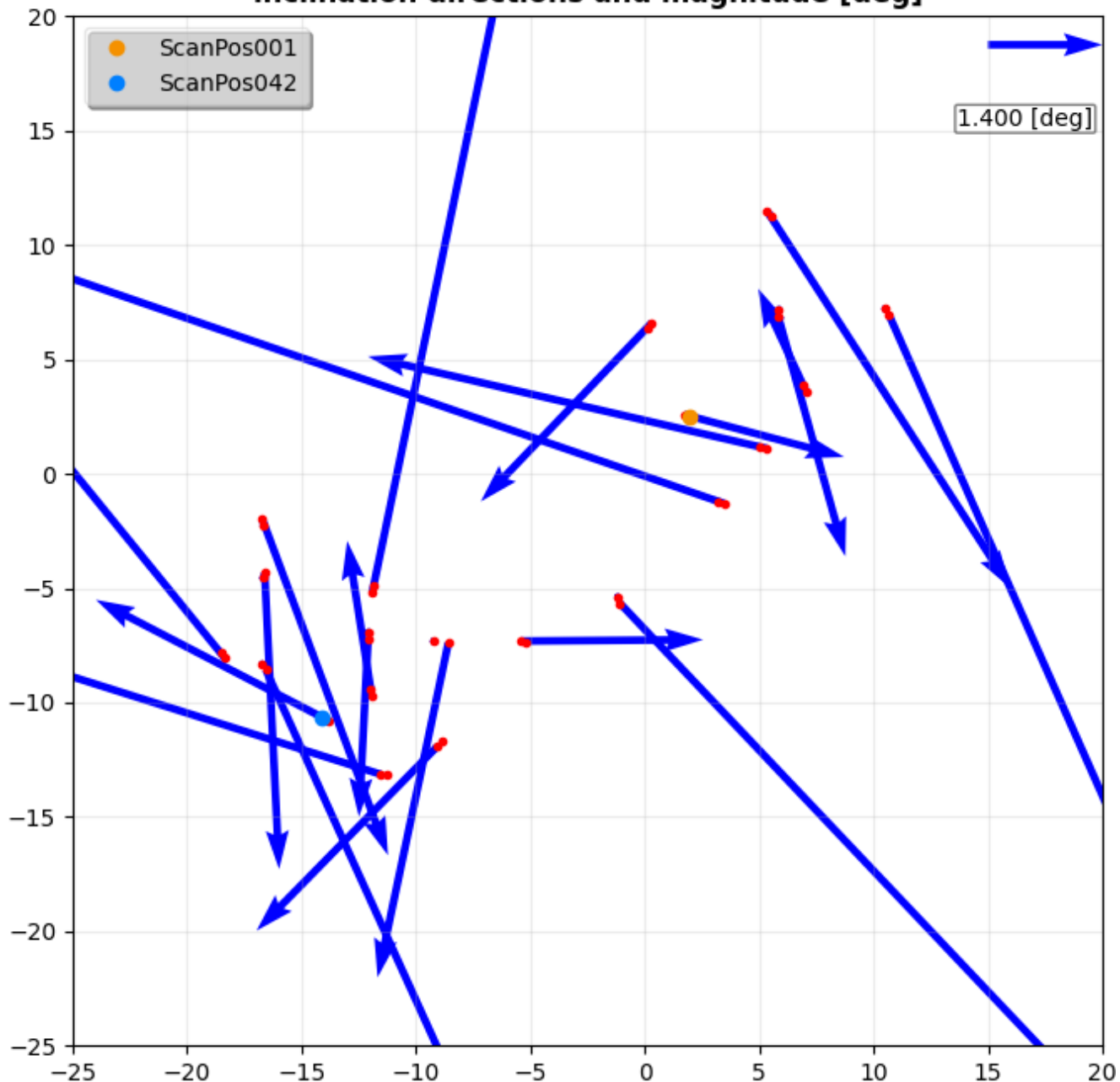
4.4 Residuals

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 | -0.0191 | -0.0011 | -0.9810 | 0.020 | 0.020 | 10.000 |
| ScanPos002 | 2.0233 | -0.2896 | -9.9000 | 0.135 | 0.135 | 10.000 |
| ScanPos003 | 0.0067 | -0.0134 | -0.9457 | 0.020 | 0.020 | 10.000 |
| ScanPos004 | -2.7882 | -1.2264 | 11.0576 | 0.137 | 0.137 | 10.000 |
| ScanPos005 | -0.0285 | -0.0120 | 1.1646 | 0.019 | 0.019 | 10.000 |
| ScanPos006 | -5.5026 | -0.1663 | -2.2702 | 0.143 | 0.143 | 10.000 |
| ScanPos007 | -0.0006 | 0.0335 | 0.5804 | 0.025 | 0.025 | 10.000 |
| ScanPos008 | 3.0400 | -0.4218 | -2.3963 | 0.136 | 0.136 | 10.000 |
| ScanPos009 | 0.0032 | 0.0152 | 0.4725 | 0.015 | 0.015 | 10.000 |

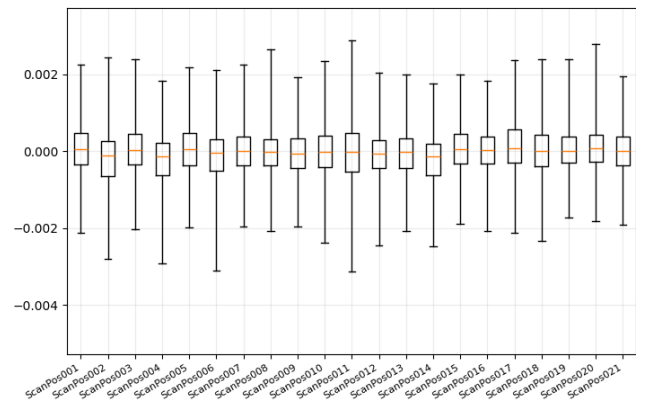
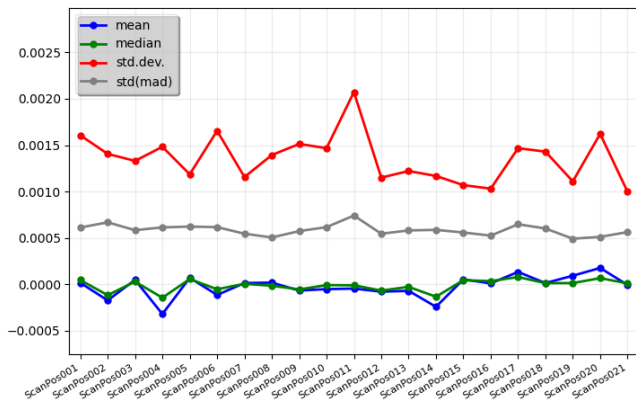
| Name | Deviations in PRCS | | | a priori Accuracies | | | |
|-------------|--------------------|-------------|-----------|---------------------|-------------|-----------|-------|
| | Roll [deg] | Pitch [deg] | Yaw [deg] | Roll [deg] | Pitch [deg] | Yaw [deg] | |
| ScanPos010 | -22.9696 | -1.3642 | 26.3116 | 0.143 | 0.143 | 10.000 | |
| ScanPos011 | -0.0346 | -0.0133 | 1.2807 | 0.022 | 0.022 | 10.000 | |
| ScanPos012 | 1.3819 | 0.0662 | 3.9346 | 0.136 | 0.136 | 10.000 | |
| ScanPos013 | -0.0105 | 0.0027 | -0.4105 | 0.012 | 0.012 | 10.000 | |
| ScanPos014 | 4.5488 | 2.1230 | 12.1700 | 0.141 | 0.141 | 10.000 | |
| ScanPos015 | 0.0126 | 0.0089 | 0.7686 | 0.016 | 0.016 | 10.000 | |
| ScanPos016 | -14.6580 | -0.7973 | 21.0643 | 0.143 | 0.143 | 10.000 | |
| ScanPos017 | 0.0103 | 0.0175 | 0.7038 | 0.020 | 0.020 | 10.000 | |
| ScanPos018 | 17.7272 | -1.6364 | -14.7579 | 0.142 | 0.142 | 10.000 | |
| ScanPos019 | -0.0283 | -0.0204 | -1.6232 | 0.021 | 0.021 | 10.000 | |
| ScanPos020 | 2.2169 | -0.4739 | -9.6194 | 0.132 | 0.132 | 10.000 | |
| ScanPos021 | -0.0278 | 0.0134 | 0.4394 | 0.022 | 0.022 | 10.000 | |
| ScanPos022 | -4.1290 | -0.8906 | 1.6062 | 0.136 | 0.136 | 10.000 | |
| ScanPos023 | 0.0156 | -0.0113 | 1.4240 | 0.018 | 0.018 | 10.000 | |
| ScanPos024 | -3.1598 | 0.1409 | -5.2060 | 0.141 | 0.141 | 10.000 | |
| ScanPos025 | 0.0042 | -0.0146 | 1.7536 | 0.018 | 0.018 | 10.000 | |
| ScanPos026 | 8.8409 | 0.4783 | -0.2813 | 0.143 | 0.143 | 10.000 | |
| ScanPos027 | -0.0062 | -0.0054 | 0.8996 | 0.012 | 0.012 | 10.000 | |
| ScanPos028 | 1.9112 | -0.0278 | 1.6565 | 0.141 | 0.141 | 10.000 | |
| ScanPos029 | -0.0131 | -0.0022 | -0.2827 | 0.016 | 0.016 | 10.000 | |
| ScanPos030 | 2.1803 | 0.0330 | 0.2986 | 0.141 | 0.141 | 10.000 | |
| ScanPos031 | -0.0191 | -0.0087 | -0.1115 | 0.012 | 0.012 | 10.000 | |
| ScanPos032 | -11.2697 | 0.4887 | -11.0389 | 0.143 | 0.143 | 10.000 | |
| ScanPos033 | -0.0028 | -0.0162 | 0.1750 | 0.015 | 0.015 | 10.000 | |
| ScanPos034 | 3.6053 | -0.7429 | 2.8844 | 0.135 | 0.135 | 10.000 | |
| ScanPos035 | -0.0212 | -0.0041 | 0.5688 | 0.021 | 0.021 | 10.000 | |
| ScanPos036 | 4.3855 | -0.6398 | -3.6548 | 0.137 | 0.137 | 10.000 | |
| ScanPos037 | -0.0133 | 0.0204 | 0.3898 | 0.014 | 0.014 | 10.000 | |
| ScanPos038 | -47.4460 | -3.1082 | 50.8744 | 0.143 | 0.143 | 10.000 | |
| ScanPos039 | 0.0716 | -0.0097 | -0.6019 | 0.010 | 0.010 | 10.000 | |
| ScanPos040 | -4.3776 | 0.4425 | -1.9546 | 0.139 | 0.139 | 10.000 | |
| ScanPos041 | -0.0124 | -0.0158 | 1.0352 | 0.015 | 0.015 | 10.000 | |
| ScanPos042 | 3.1233 | 0.1210 | -6.9950 | 0.142 | 0.142 | 10.000 | |
| Statistics | mean | median | std. dev. | std(mad) | min | max | count |
| Roll [deg] | -1.4626 | -0.0045 | 9.2565 | 1.0842 | -47.4460 | 17.7272 | 42 |
| Pitch [deg] | -0.1888 | -0.0105 | 0.7291 | 0.0552 | -3.1082 | 2.1230 | 42 |
| Yaw [deg] | 1.6782 | 0.4146 | 10.4167 | 1.9133 | -14.7579 | 50.8744 | 42 |
| Roll [1] | -10.200 | -0.365 | 64.985 | 13.140 | -332.141 | 125.125 | 42 |
| Pitch [1] | -1.421 | -0.620 | 5.175 | 2.002 | -21.759 | 15.076 | 42 |
| Yaw [1] | 0.168 | 0.041 | 1.042 | 0.191 | -1.476 | 5.087 | 42 |

4.4.2 Plane Patches

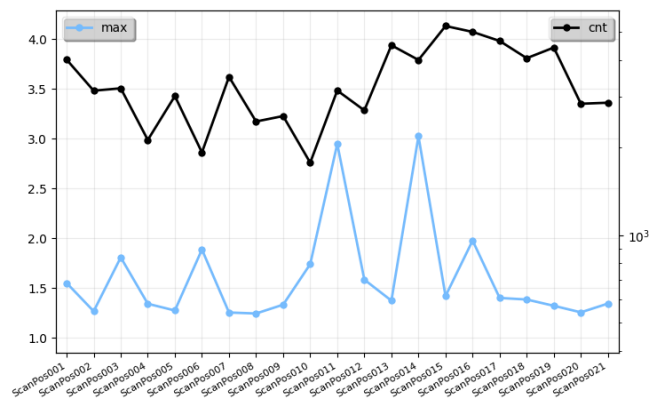
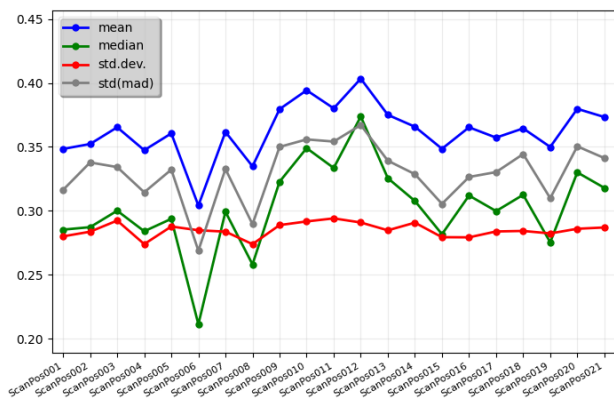
The subsequent figures show the residuals in distance and angle of all plane patches per scan position, expressed as mean, median, standard deviation and median absolute deviation (std(mad)). Additionally, the figures depict the number of plane patches available for every scan position.

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.

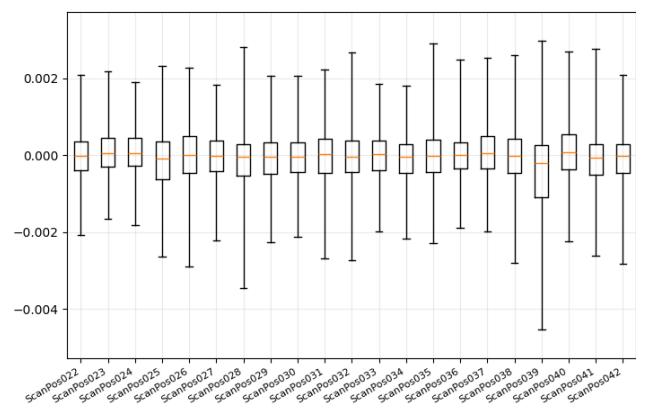
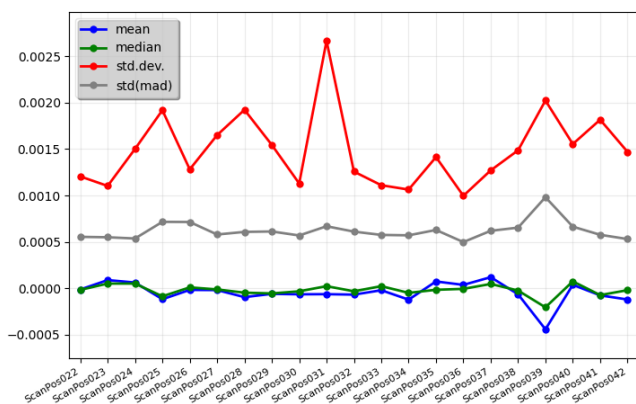
residuals in distance [m]



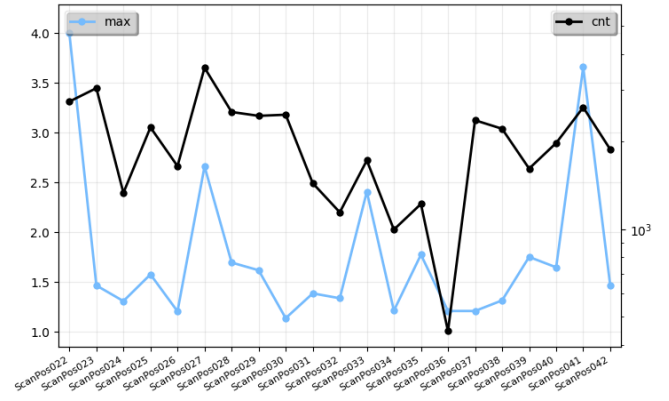
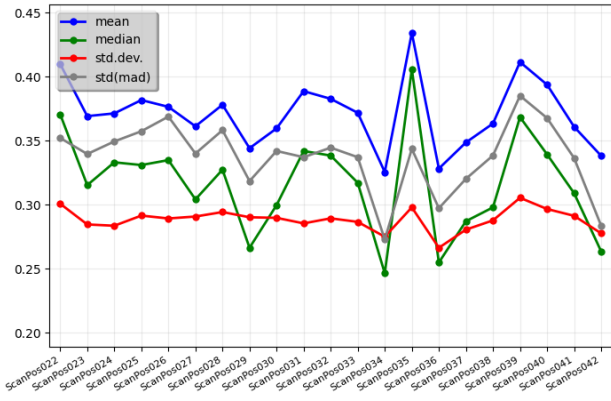
residuals in angle [deg]



residuals in distance [m]



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 | 4010 | 0.0000 | 0.0000 | 0.0016 | 0.0006 | -0.0279 | -0.0021 | -0.0003 | 0.0005 | 0.0023 | 0.0179 |
| ScanPos002 | 3136 | -0.0002 | -0.0001 | 0.0014 | 0.0007 | -0.0160 | -0.0028 | -0.0007 | 0.0003 | 0.0024 | 0.0099 |
| ScanPos003 | 3196 | 0.0000 | 0.0000 | 0.0013 | 0.0006 | -0.0159 | -0.0020 | -0.0004 | 0.0004 | 0.0024 | 0.0128 |
| ScanPos004 | 2124 | -0.0003 | -0.0001 | 0.0015 | 0.0006 | -0.0199 | -0.0029 | -0.0006 | 0.0002 | 0.0018 | 0.0079 |
| ScanPos005 | 3006 | 0.0001 | 0.0001 | 0.0012 | 0.0006 | -0.0078 | -0.0020 | -0.0004 | 0.0005 | 0.0022 | 0.0105 |
| ScanPos006 | 1924 | -0.0001 | -0.0001 | 0.0017 | 0.0006 | -0.0098 | -0.0031 | -0.0005 | 0.0003 | 0.0021 | 0.0281 |
| ScanPos007 | 3500 | 0.0000 | 0.0000 | 0.0012 | 0.0005 | -0.0070 | -0.0020 | -0.0004 | 0.0004 | 0.0023 | 0.0223 |
| ScanPos008 | 2458 | 0.0000 | -0.0000 | 0.0014 | 0.0005 | -0.0165 | -0.0021 | -0.0004 | 0.0003 | 0.0027 | 0.0136 |
| ScanPos009 | 2566 | -0.0001 | -0.0001 | 0.0015 | 0.0006 | -0.0207 | -0.0020 | -0.0004 | 0.0003 | 0.0019 | 0.0289 |
| ScanPos010 | 1774 | -0.0001 | -0.0000 | 0.0015 | 0.0006 | -0.0199 | -0.0024 | -0.0004 | 0.0004 | 0.0023 | 0.0119 |
| ScanPos011 | 3140 | -0.0000 | -0.0000 | 0.0021 | 0.0007 | -0.0192 | -0.0031 | -0.0005 | 0.0005 | 0.0029 | 0.0297 |
| ScanPos012 | 2684 | -0.0001 | -0.0001 | 0.0012 | 0.0005 | -0.0128 | -0.0024 | -0.0004 | 0.0003 | 0.0020 | 0.0096 |
| ScanPos013 | 4492 | -0.0001 | -0.0000 | 0.0012 | 0.0006 | -0.0216 | -0.0021 | -0.0004 | 0.0003 | 0.0020 | 0.0099 |
| ScanPos014 | 4000 | -0.0002 | -0.0001 | 0.0012 | 0.0006 | -0.0203 | -0.0025 | -0.0006 | 0.0002 | 0.0018 | 0.0123 |
| ScanPos015 | 5232 | 0.0001 | 0.0000 | 0.0011 | 0.0006 | -0.0128 | -0.0019 | -0.0003 | 0.0004 | 0.0020 | 0.0118 |
| ScanPos016 | 4994 | 0.0000 | 0.0000 | 0.0010 | 0.0005 | -0.0148 | -0.0021 | -0.0003 | 0.0004 | 0.0018 | 0.0131 |
| ScanPos017 | 4648 | 0.0001 | 0.0001 | 0.0015 | 0.0006 | -0.0128 | -0.0021 | -0.0003 | 0.0006 | 0.0024 | 0.0374 |
| ScanPos018 | 4056 | 0.0000 | 0.0000 | 0.0014 | 0.0006 | -0.0211 | -0.0023 | -0.0004 | 0.0004 | 0.0024 | 0.0189 |
| ScanPos019 | 4412 | 0.0001 | 0.0000 | 0.0011 | 0.0005 | -0.0115 | -0.0017 | -0.0003 | 0.0004 | 0.0024 | 0.0116 |
| ScanPos020 | 2828 | 0.0002 | 0.0001 | 0.0016 | 0.0005 | -0.0112 | -0.0018 | -0.0003 | 0.0004 | 0.0028 | 0.0392 |
| ScanPos021 | 2852 | -0.0000 | 0.0000 | 0.0010 | 0.0006 | -0.0098 | -0.0019 | -0.0004 | 0.0004 | 0.0019 | 0.0061 |
| ScanPos022 | 2742 | -0.0000 | -0.0000 | 0.0012 | 0.0006 | -0.0119 | -0.0021 | -0.0004 | 0.0003 | 0.0021 | 0.0120 |
| ScanPos023 | 3050 | 0.0001 | 0.0001 | 0.0011 | 0.0006 | -0.0198 | -0.0017 | -0.0003 | 0.0004 | 0.0022 | 0.0088 |
| ScanPos024 | 1332 | 0.0001 | 0.0001 | 0.0015 | 0.0005 | -0.0210 | -0.0018 | -0.0003 | 0.0005 | 0.0019 | 0.0161 |
| ScanPos025 | 2236 | -0.0001 | -0.0001 | 0.0019 | 0.0007 | -0.0384 | -0.0027 | -0.0006 | 0.0004 | 0.0023 | 0.0161 |
| ScanPos026 | 1646 | -0.0000 | 0.0000 | 0.0013 | 0.0007 | -0.0082 | -0.0029 | -0.0005 | 0.0005 | 0.0023 | 0.0093 |
| ScanPos027 | 3584 | -0.0000 | -0.0000 | 0.0017 | 0.0006 | -0.0383 | -0.0022 | -0.0004 | 0.0004 | 0.0018 | 0.0207 |
| ScanPos028 | 2526 | -0.0001 | -0.0000 | 0.0019 | 0.0006 | -0.0124 | -0.0035 | -0.0005 | 0.0003 | 0.0028 | 0.0229 |
| ScanPos029 | 2450 | -0.0001 | -0.0001 | 0.0015 | 0.0006 | -0.0130 | -0.0023 | -0.0005 | 0.0003 | 0.0021 | 0.0302 |

| | | Plane Patch Residuals of Distance [m] | | | | | | | | | |
|------------|-----------------|---------------------------------------|---------|-----------|----------|---------|---------|---------|--------|--------|--------|
| Name | # plane patches | mean | median | std. dev. | std(mad) | min | q2.5% | q25% | q75% | q97.5% | max |
| ScanPos030 | 2472 | -0.0001 | -0.0000 | 0.0011 | 0.0006 | -0.0098 | -0.0021 | -0.0004 | 0.0003 | 0.0021 | 0.0134 |
| ScanPos031 | 1438 | -0.0001 | 0.0000 | 0.0027 | 0.0007 | -0.0467 | -0.0027 | -0.0005 | 0.0004 | 0.0022 | 0.0242 |
| ScanPos032 | 1142 | -0.0001 | -0.0000 | 0.0013 | 0.0006 | -0.0101 | -0.0027 | -0.0004 | 0.0004 | 0.0027 | 0.0062 |
| ScanPos033 | 1722 | -0.0000 | 0.0000 | 0.0011 | 0.0006 | -0.0107 | -0.0020 | -0.0004 | 0.0004 | 0.0018 | 0.0121 |
| ScanPos034 | 996 | -0.0001 | -0.0000 | 0.0011 | 0.0006 | -0.0117 | -0.0022 | -0.0005 | 0.0003 | 0.0018 | 0.0056 |
| ScanPos035 | 1220 | 0.0001 | -0.0000 | 0.0014 | 0.0006 | -0.0061 | -0.0023 | -0.0004 | 0.0004 | 0.0029 | 0.0136 |
| ScanPos036 | 446 | 0.0000 | -0.0000 | 0.0010 | 0.0005 | -0.0025 | -0.0019 | -0.0003 | 0.0003 | 0.0025 | 0.0078 |
| ScanPos037 | 2366 | 0.0001 | 0.0000 | 0.0013 | 0.0006 | -0.0119 | -0.0020 | -0.0003 | 0.0005 | 0.0025 | 0.0163 |
| ScanPos038 | 2212 | -0.0001 | -0.0000 | 0.0015 | 0.0007 | -0.0163 | -0.0028 | -0.0005 | 0.0004 | 0.0026 | 0.0092 |
| ScanPos039 | 1614 | -0.0004 | -0.0002 | 0.0020 | 0.0010 | -0.0150 | -0.0045 | -0.0011 | 0.0003 | 0.0030 | 0.0162 |
| ScanPos040 | 1976 | 0.0000 | 0.0001 | 0.0016 | 0.0007 | -0.0270 | -0.0022 | -0.0004 | 0.0005 | 0.0027 | 0.0091 |
| ScanPos041 | 2620 | -0.0001 | -0.0001 | 0.0018 | 0.0006 | -0.0161 | -0.0026 | -0.0005 | 0.0003 | 0.0028 | 0.0219 |
| ScanPos042 | 1878 | -0.0001 | -0.0000 | 0.0015 | 0.0005 | -0.0128 | -0.0028 | -0.0005 | 0.0003 | 0.0021 | 0.0199 |
| | | Plane Patch Angular Residuals [deg] | | | | | | | | | |
| Name | # plane patches | mean | median | std. dev. | std(mad) | min | q2.5% | q25% | q75% | q97.5% | max |
| ScanPos001 | 4010 | 0.3484 | 0.2854 | 0.2801 | 0.3164 | 0.0005 | 0.0091 | 0.0931 | 0.5751 | 0.9107 | 1.5514 |
| ScanPos002 | 3136 | 0.3523 | 0.2873 | 0.2838 | 0.3379 | 0.0002 | 0.0087 | 0.0870 | 0.5854 | 0.9246 | 1.2678 |
| ScanPos003 | 3196 | 0.3653 | 0.3001 | 0.2925 | 0.3342 | 0.0014 | 0.0108 | 0.1025 | 0.5998 | 0.9413 | 1.8080 |
| ScanPos004 | 2124 | 0.3474 | 0.2841 | 0.2741 | 0.3146 | 0.0013 | 0.0109 | 0.1003 | 0.5599 | 0.9029 | 1.3429 |
| ScanPos005 | 3006 | 0.3606 | 0.2938 | 0.2878 | 0.3323 | 0.0004 | 0.0066 | 0.0967 | 0.5981 | 0.9352 | 1.2754 |
| ScanPos006 | 1924 | 0.3042 | 0.2115 | 0.2849 | 0.2689 | 0.0006 | 0.0050 | 0.0600 | 0.5075 | 0.9061 | 1.8871 |
| ScanPos007 | 3500 | 0.3617 | 0.2993 | 0.2838 | 0.3327 | 0.0005 | 0.0086 | 0.1010 | 0.5944 | 0.9282 | 1.2552 |
| ScanPos008 | 2458 | 0.3348 | 0.2582 | 0.2740 | 0.2896 | 0.0009 | 0.0101 | 0.1008 | 0.5398 | 0.9176 | 1.2453 |
| ScanPos009 | 2566 | 0.3795 | 0.3228 | 0.2889 | 0.3500 | 0.0008 | 0.0129 | 0.1094 | 0.6137 | 0.9339 | 1.3336 |
| ScanPos010 | 1774 | 0.3943 | 0.3490 | 0.2918 | 0.3559 | 0.0008 | 0.0115 | 0.1273 | 0.6180 | 0.9330 | 1.7404 |
| ScanPos011 | 3140 | 0.3801 | 0.3336 | 0.2942 | 0.3542 | 0.0003 | 0.0084 | 0.1115 | 0.6056 | 0.9357 | 2.9469 |
| ScanPos012 | 2684 | 0.4033 | 0.3737 | 0.2910 | 0.3671 | 0.0007 | 0.0164 | 0.1396 | 0.6359 | 0.9498 | 1.5849 |
| ScanPos013 | 4492 | 0.3751 | 0.3256 | 0.2848 | 0.3392 | 0.0006 | 0.0091 | 0.1182 | 0.5944 | 0.9405 | 1.3743 |
| ScanPos014 | 4000 | 0.3658 | 0.3078 | 0.2908 | 0.3287 | 0.0005 | 0.0106 | 0.1119 | 0.5901 | 0.9173 | 3.0237 |
| ScanPos015 | 5232 | 0.3485 | 0.2818 | 0.2795 | 0.3055 | 0.0006 | 0.0109 | 0.1033 | 0.5620 | 0.9272 | 1.4201 |
| ScanPos016 | 4994 | 0.3653 | 0.3120 | 0.2794 | 0.3265 | 0.0013 | 0.0115 | 0.1164 | 0.5832 | 0.9242 | 1.9769 |
| ScanPos017 | 4648 | 0.3573 | 0.2999 | 0.2839 | 0.3303 | 0.0004 | 0.0096 | 0.1002 | 0.5667 | 0.9294 | 1.4015 |
| ScanPos018 | 4056 | 0.3645 | 0.3126 | 0.2843 | 0.3444 | 0.0007 | 0.0090 | 0.1058 | 0.5833 | 0.9293 | 1.3856 |
| ScanPos019 | 4412 | 0.3500 | 0.2755 | 0.2824 | 0.3099 | 0.0005 | 0.0101 | 0.1027 | 0.5671 | 0.9294 | 1.3226 |
| ScanPos020 | 2828 | 0.3798 | 0.3301 | 0.2861 | 0.3505 | 0.0014 | 0.0101 | 0.1188 | 0.6173 | 0.9336 | 1.2569 |
| ScanPos021 | 2852 | 0.3733 | 0.3180 | 0.2871 | 0.3413 | 0.0013 | 0.0173 | 0.1098 | 0.5984 | 0.9326 | 1.3448 |
| ScanPos022 | 2742 | 0.4100 | 0.3707 | 0.3009 | 0.3522 | 0.0002 | 0.0162 | 0.1553 | 0.6386 | 0.9415 | 3.9996 |
| ScanPos023 | 3050 | 0.3693 | 0.3154 | 0.2847 | 0.3397 | 0.0000 | 0.0076 | 0.1087 | 0.5936 | 0.9288 | 1.4659 |
| ScanPos024 | 1332 | 0.3715 | 0.3332 | 0.2837 | 0.3495 | 0.0009 | 0.0091 | 0.1087 | 0.6020 | 0.9174 | 1.3089 |
| ScanPos025 | 2236 | 0.3819 | 0.3311 | 0.2916 | 0.3575 | 0.0012 | 0.0077 | 0.1114 | 0.6285 | 0.9391 | 1.5767 |

| | | Plane Patch Angular Residuals [deg] | | | | | | | | | |
|------------|-----------------|-------------------------------------|--------|-----------|----------|--------|--------|--------|--------|--------|--------|
| Name | # plane patches | mean | median | std. dev. | std(mad) | min | q2.5% | q25% | q75% | q97.5% | max |
| ScanPos026 | 1646 | 0.3766 | 0.3350 | 0.2894 | 0.3690 | 0.0014 | 0.0088 | 0.1057 | 0.6232 | 0.9308 | 1.2060 |
| ScanPos027 | 3584 | 0.3614 | 0.3043 | 0.2909 | 0.3401 | 0.0002 | 0.0093 | 0.0954 | 0.5948 | 0.9197 | 2.6602 |
| ScanPos028 | 2526 | 0.3782 | 0.3275 | 0.2944 | 0.3584 | 0.0004 | 0.0121 | 0.1048 | 0.6046 | 0.9417 | 1.6956 |
| ScanPos029 | 2450 | 0.3443 | 0.2665 | 0.2903 | 0.3186 | 0.0006 | 0.0081 | 0.0864 | 0.5674 | 0.9291 | 1.6184 |
| ScanPos030 | 2472 | 0.3597 | 0.2998 | 0.2899 | 0.3421 | 0.0007 | 0.0104 | 0.0955 | 0.6042 | 0.9459 | 1.1376 |
| ScanPos031 | 1438 | 0.3888 | 0.3421 | 0.2855 | 0.3372 | 0.0012 | 0.0109 | 0.1357 | 0.6251 | 0.9263 | 1.3864 |
| ScanPos032 | 1142 | 0.3829 | 0.3385 | 0.2895 | 0.3447 | 0.0039 | 0.0166 | 0.1201 | 0.5996 | 0.9368 | 1.3375 |
| ScanPos033 | 1722 | 0.3719 | 0.3173 | 0.2867 | 0.3373 | 0.0003 | 0.0123 | 0.1120 | 0.5936 | 0.9204 | 2.4070 |
| ScanPos034 | 996 | 0.3256 | 0.2465 | 0.2751 | 0.2729 | 0.0038 | 0.0145 | 0.0875 | 0.5284 | 0.9144 | 1.2133 |
| ScanPos035 | 1220 | 0.4344 | 0.4059 | 0.2980 | 0.3437 | 0.0037 | 0.0222 | 0.1797 | 0.6454 | 0.9685 | 1.7746 |
| ScanPos036 | 446 | 0.3283 | 0.2550 | 0.2665 | 0.2974 | 0.0016 | 0.0120 | 0.0929 | 0.5219 | 0.8971 | 1.2096 |
| ScanPos037 | 2366 | 0.3487 | 0.2872 | 0.2806 | 0.3203 | 0.0003 | 0.0070 | 0.0925 | 0.5620 | 0.9199 | 1.2097 |
| ScanPos038 | 2212 | 0.3635 | 0.2980 | 0.2879 | 0.3386 | 0.0010 | 0.0082 | 0.1020 | 0.6085 | 0.9366 | 1.3158 |
| ScanPos039 | 1614 | 0.4116 | 0.3685 | 0.3055 | 0.3853 | 0.0003 | 0.0103 | 0.1332 | 0.6697 | 0.9697 | 1.7520 |
| ScanPos040 | 1976 | 0.3939 | 0.3395 | 0.2968 | 0.3678 | 0.0007 | 0.0117 | 0.1198 | 0.6398 | 0.9524 | 1.6479 |
| ScanPos041 | 2620 | 0.3610 | 0.3091 | 0.2914 | 0.3366 | 0.0010 | 0.0121 | 0.1066 | 0.5794 | 0.9118 | 3.6564 |
| ScanPos042 | 1878 | 0.3383 | 0.2637 | 0.2777 | 0.2837 | 0.0022 | 0.0097 | 0.0960 | 0.5304 | 0.9201 | 1.4633 |