



LiDAR calibration report

Optech Galaxy T2000 SN 5060489

2023/07/19

Written by
Validated by

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1. Calibration site presentation

1.1. Calibration presentation

The calibration flight is realized above our calibration area over sant Andreu de la Barca close to Barcelona. This calibration site is interesting because, we encounter:

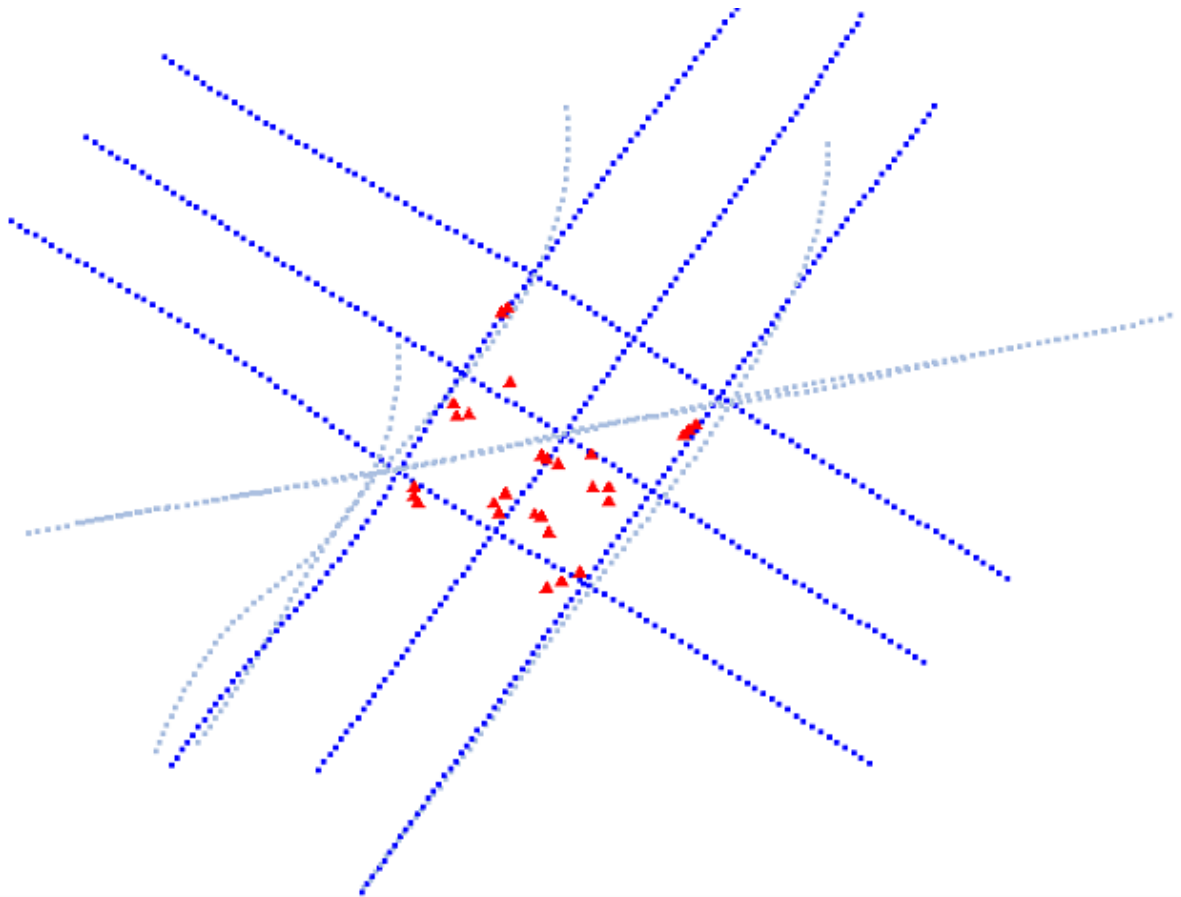
- Urban area,
- River
- Infrastructure
- Highway
- Forest
- Hills



Calibration flight plan

1.2. Ground Control Point

The calibration site is composed of 28 points measured by differential GNSS with centimetric accuracy.



Ground control point distribution

1.3. Acquisition flight

This calibration flight was realized with the parameters below.

Acquisition parameters	Unit	Galaxy T2000
<i>Point density</i>	Pts/m ²	10
<i>Flight Elevation</i>	ft (AGL)	1150
<i>Speed</i>	kts	115
<i>Air vector</i>		Aircraft
<i>Scan frequency</i>	Hz	40
<i>Scan angle (FOV)</i>	deg	+/- 25
<i>Pulse frequency (PRF)</i>	kHz	100
<i>Lateral covering</i>	%	60

Tableau des paramètres lidar

The flight was realized the 2023/07/19 between 10:15 and 10:34.

Strip ID	Start (s)	Stop (s)	Duration (s)	PRF (kHz)	Scan frequency (Hz)	Full Scan Swath (deg)	Speed Avg (m/s)	Height Avg (m)
3	294723.0	294774.8	51.9	100	40	50	62.9	1192.1
4	294896.6	294949.4	52.8	100	40	50	60.6	1160.3
6	295389.4	295443.1	53.7	100	40	50	62.2	1146.3
7	295643.2	295697.9	54.7	100	40	50	62.2	1163.7
8	296053.0	296106.7	53.7	100	40	50	62.6	1157.4
9	296375.0	296428.7	53.7	100	40	50	64.4	1181.5

1.4. Geometric Calibration

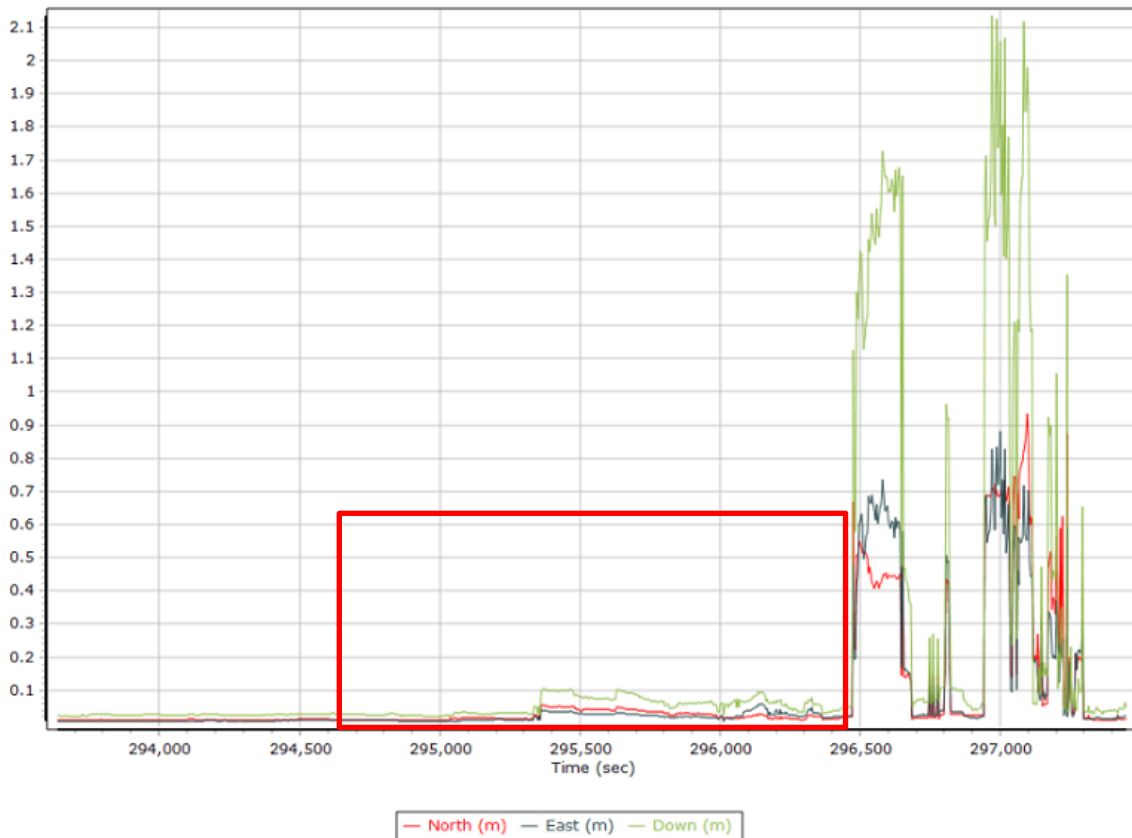
1.4.1. Trajectory computation

The trajectory computation was realized with POSPAC :

- XY < 5 cm
- Z < 10 cm

The lines concerned by the calibration are marked with the red rectangle.

Estimated Position Accuracy

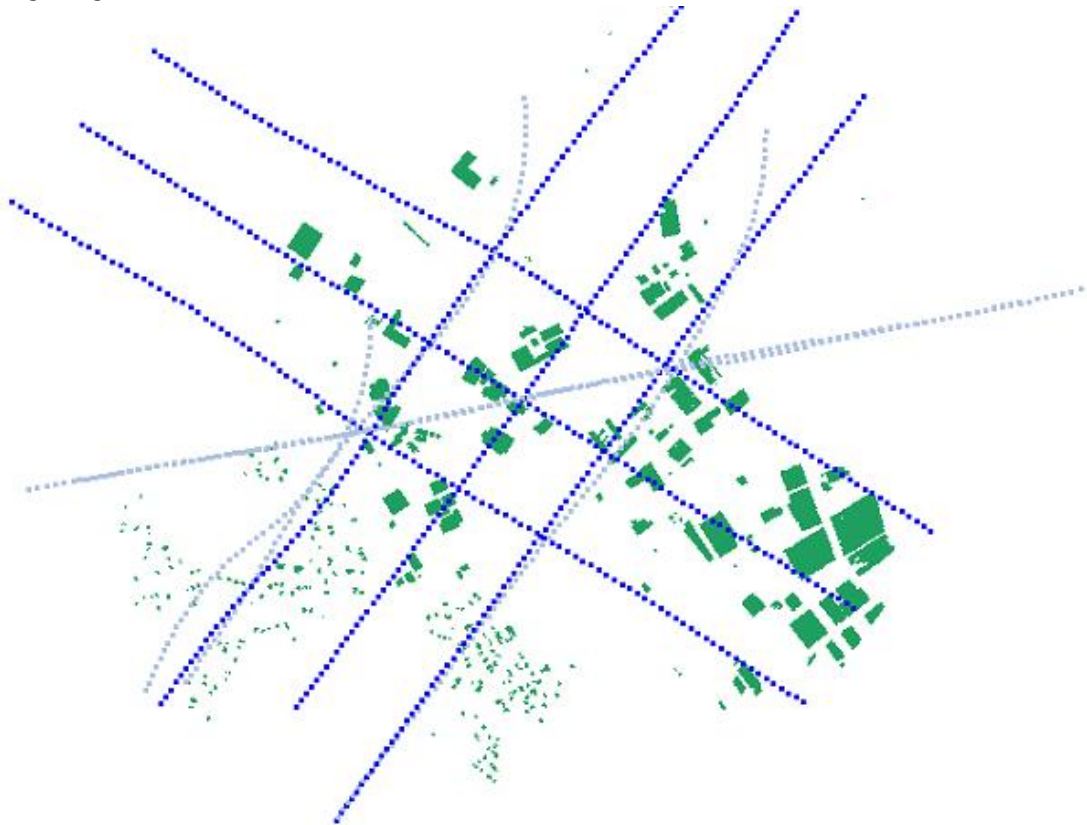


1.4.2. LMS calculation

The parameters calibrated on Lidar Mapping Suite concern:

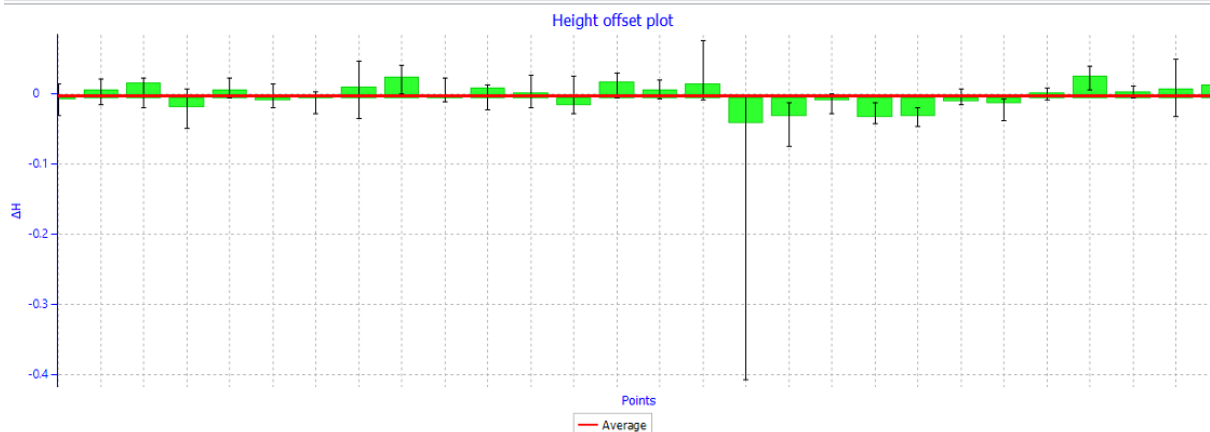
- Boresight angles computed with roof lines detection
- Polynomial sensor computed with all surfaces area

The following images show the results obtained:



Configuration of detected planes for boresight calibration

Number of selected control points
 Average height difference
 Standard deviation



Residual deviations on control surfaces

Summary Statistic of Roof Lines Separation

Number of Roof Lines:

Coordinate	Unit	# Values	Average	RMS
Δ East	m	3265	-0.000	0.034
Δ North	m	3265	-0.002	0.040
Δ Height	m	3265	-0.001	0.046
Δ Horizontal	m	3265	0.002	0.052

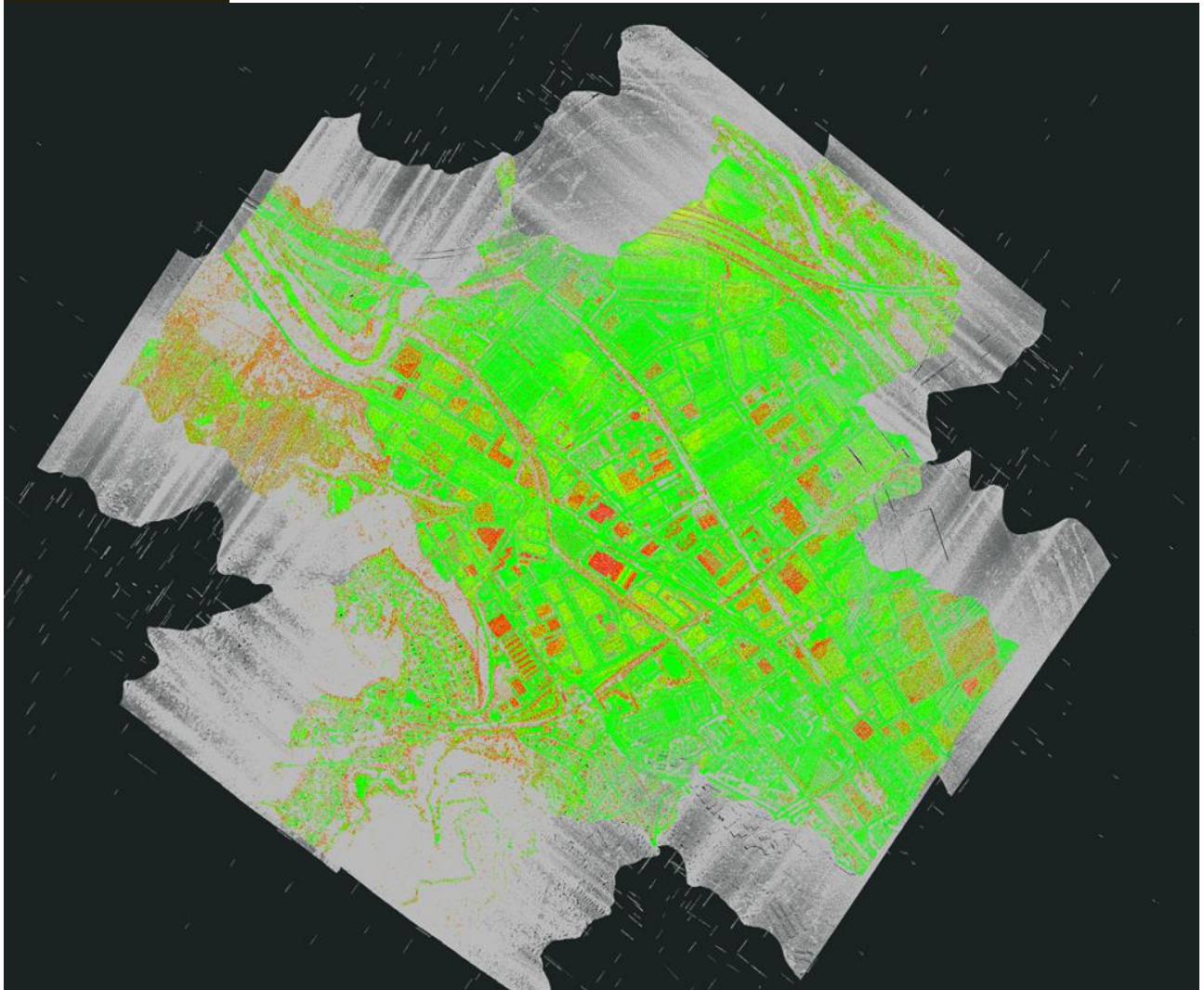
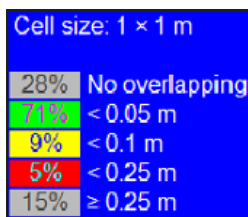
Planimetric and altimetric residuals on roof line

Summary Statistic of Laser Points to Tie Planes Separation

Number of Tie Planes:

TP Slope	Unit	# Values	Average	RMS
$0 \leq \alpha < 5$	m	9281802	-0.000	0.027
$5 \leq \alpha < 15$	m	3787542	0.000	0.024
$15 \leq \alpha < 30$	m	1566261	-0.000	0.028
$30 \leq \alpha < 85$	m	99542	-0.000	0.032
$85 \leq \alpha \leq 90$	m	3960	-0.000	0.049
Total	m	14739107	-0.000	0.026

3D deviations on all detected planes



Elevation difference map



1.5. LCP file

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<boost_serialization xmlns="http://lcp" signature="serialization::archive" version="3">
  <calibration_parameters version="2">
    <type>altm</type>
    <time-sync>
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        <dt_millisec>-0.7390392551859092</dt_millisec>
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    </time-sync>
    <lasers>
      <item>
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        <beam-roll>-0.000000024</beam-roll>
        <beam-pitch>-0.289626014</beam-pitch>
      </item>
    </lasers>
    <scan-lag>
      <dt_lag_microsec>19.938953371552</dt_lag_microsec>
    </scan-lag>
    <droop-scanner-polynomials>
      <item>
        <id>1</id>
        <dp0>-0.040032020106000000</dp0>
        <dp1>0.083312615048000000</dp1>
        <dn0>-0.046040849090500000</dn0>
        <dn1>0.078953794328000010</dn1>
        <a0>-0.000000025</a0>
        <a1>0.989662431197016900</a1>
        <a2>-0.000081394189990260</a2>
        <a3>-0.000008589188015544</a3>
        <a4>0.000000094044675876</a4>
        <a5>0.000000005271796559</a5>
        <a6>-0.000000000056278649</a6>
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    </droop-scanner-polynomials>
```





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<boresights>
  <item>
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    <imu_ex>0.174479581</imu_ex>
    <imu_ey>0.158105174</imu_ey>
    <imu_ez>-0.143742933</imu_ez>
    <pos_dx>-0.005488</pos_dx>
    <pos_dy>0.004859</pos_dy>
    <pos_dz>-0.146476</pos_dz>
  </item>
</boresights>
</calibration_parameters>
</boost_serialization>
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