LiDAR Data Quality Overview - 2011

This report describes issues that may affect the quality of your LiDAR dataset and what should be considered for further processing of your dataset. It is anticipated that the document will be updated throughout the year, the latest version of which will be available at:

http://arsf-dan.nerc.ac.uk/trac/wiki/Reports

Geo-referencing accuracy

Currently, the ARSF delivers LiDAR datasets in ASCII point cloud format with separate files per flight line. Prior to delivery, each flight line is compared to its neighbouring lines to compare respective elevation in overlapping regions and also horizontal planar shifts. For UK flights where vectors are available, we compare the horizontal planar accuracy to these vectors.

If ground control points (GCPs) are available for the region then we will use these as a control to correct for possible elevation errors in the LiDAR data. If no GCPs or accurate ground truth are available then no height correction will be applied, but an average per-line elevation difference for the overlapping region may be included within the readme file of your delivery.

Roll Boresight Error

Unfortunately there is an an issue with the roll boresight angle such that it varies between flight lines flown at different heights. This error has been present since February 2009. No definite trend in the variations is apparent at the moment but the roll boresight value does differ between flight lines collected on the same day.

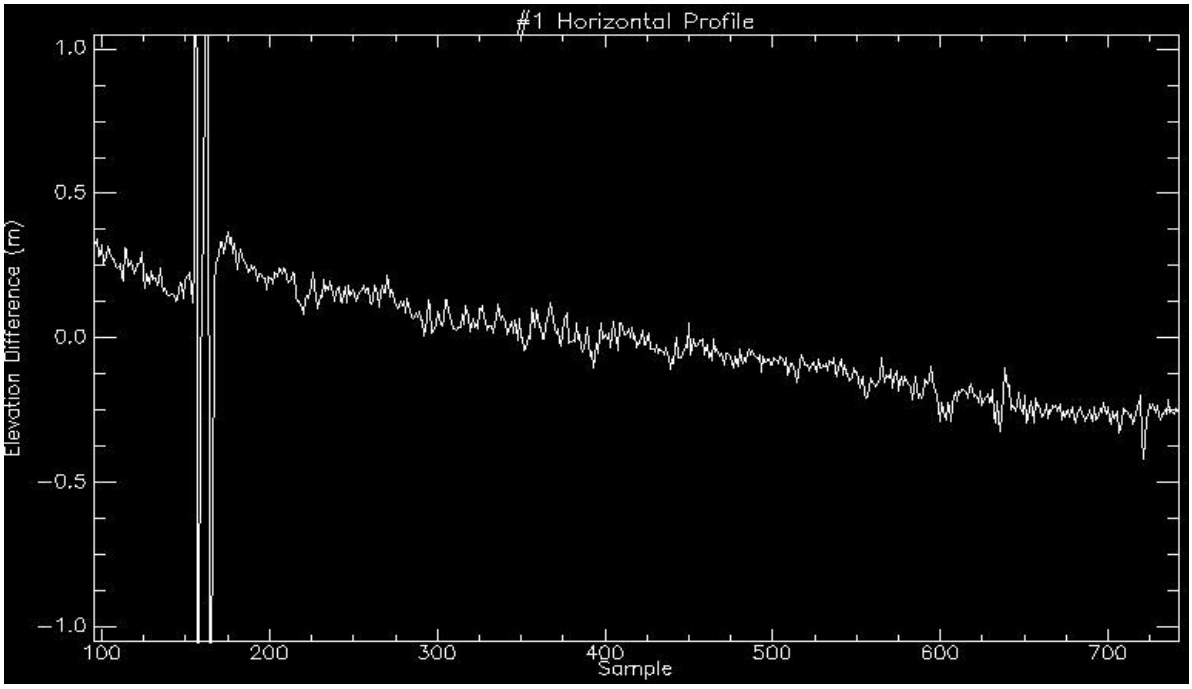

Figure 1: Elevation difference between two point clouds from opposing flight lines flown at 2000m altitude, showing an across track slope. Note large spikes are due to hedge rows.

Figure 1 shows the elevation difference between two point clouds from opposing flight lines flown at 2000m altitude. The difference should be flat and close to zero but a slope across track is clearly visible with a magnitude of approximately 55cm change across the swath.

The current protocol for dealing with this issue in the data is to manually boresight using the overlapping areas between different point clouds as a guide, iteratively processing until there are no relative trends between the neighbouring point clouds.

If there are no areas of overlap between neighbouring flight lines then this issue can not currently be corrected for and an unknown roll error will remain in the dataset.

This issue has been found to be present in other Leica Geosystems LiDAR sensors and is not system specific. The source of this systematic bias is currently under investigation by Leica Geosystems.

Data Accuracy

A calibration flight is preformed each time the sensor is removed from the aircraft for maintenance or system updates.

For each calibration the accuracy of the LiDAR elevation has been compared to GCP's using TerraScan software. This creates a surface from LiDAR points near to the GCP and then compares the GCP against the surface elevation. A short summary of the results of each calibration is given below.

Flights April 2011

The NERC-ARSF LiDAR system experienced technical failure in early April 2011 and was temporarily unavailable. A loan system was installed by Leica Geosystems which was used to collect data for the duration of April 2011.

An initial calibration flight was flown over Little Rissington. This data was found to suffer from intermittent hardware failure resulting in some flightlines having incorrect intensity values. As a result there was insufficient data to calculate the boresight angles. A second calibration flight was flown a week later over downtown Gloucester, an area of high contrast relief, allowing accurate calculation the boresight angles.

The data from Little Rissington, together with the GCP data, was then used to range correct the LiDAR. The comparison between LiDAR and GCPs gives:

- Mean error magnitude of 2.9cm with a standard deviation of 2.7 cm for the ~1600m altitude data
- Mean error magnitude of 2.4cm with a standard deviation of 2.8cm for the ~2550m altitude data.

There is evidence of a systematic roll boresight error present in this data, with an error of 10-15cm in magnitude.

Classification

We run a basic classification routine on all processed data to highlight any noisy points. This includes low points appearing below the ground, high points that may be due to haze and isolated points due to systematic noise. We do quality check the data, however we do not perform rigorous verification of the

classification. As a result some erroneous points may remain in your data.

In your delivery points, deemed to be noise will have classification of 7 whilst all other points will have a classification of 1, following the ASPRS standards on LiDAR classification.

We do not remove noisy points in case, for your studies, they are points of interest. However, a program included with your delivery can be used to create new point cloud files which only contain points of certain classifications.

Digital Elevation Model (DEM)

In most cases we will generate a DEM during the processing of your LiDAR dataset which can be used to aid the processing of Eagle/Hawk hyperspectral data. If this is the case it will be included with your delivery with a description of the DEM in the readme file (including pixel resolution, datum information and a description of the header format).

Your hyperspectral data coverage may extend further than your LiDAR data. Where possible we will patch external DEM data to your LiDAR DEM. Please see the readme included with your delivery for specific information relating to your project.

If you wish create your own DEM from your LiDAR data please see our notes at:

http://arsf-dan.nerc.ac.uk/trac/wiki/Help/LeicaLidarDems.