SURVEY REPORT

FOR

VALDEZ, ALASKA
LOW ALITITUDE LIDAR

AERO-METRIC, INC.

APRIL 28, 2008

USGS CONTRACT NO. 07CRCN0002

USGS TASK ORDER NO: 070020009

Table of Contents

Overview

During 2007, the United States Geological Survey (USGS) awarded the contract number 07CRCN0002 to Aero-Metric, to provide Aerial Imagery and LIDAR Acquisition, and Digital Orthophoto Production. This report will focus on the low altitude/ high resolution LIDAR acquisition portion of the contract. High altitude/ low resolution LIDAR was also collected for this contract and was discussed in the report titled: Survey Report for Valdez, Alaska High Altitude LIDAR, dated March 28, 2008.

On October 16, 2007 airborne LIDAR was collected to acquire some of the high resolution LIDAR area. This mission was named 43Q28907A. Other missions were flown to collect high resolution LIDAR, but due to sensor malfunctions, the data collected was found to be of unacceptable quality.

At the time of acquisition it was thought the data was able to be fixed using software techniques. In February of 2008, Aero-Metric was informed by the LIDAR's manufacturer, Optech, Inc.; the poor quality data stemmed from a hardware malfunction, and could not be fixed using software. Optech has since repaired the sensor and tests have shown the system is operating properly. The remaining data will be collected in 2008.

The data included in this delivery is divided into 1000 meter by 1000 meter tiles. The areas covered by tiles 36-52 and 74-90 will not be included in this delivery. These tiles are not included due to insufficient point density; addition data will be collected in 2008 in order to meet the contract specifications.

LIDAR Acquisition Planning

The LIDAR data for this project was collected with Aero-Metric's Optech Gemini-167 Airborne LIDAR system (Serial Number 03SEN145). All flight planning and acquisition was completed using Optech's ALTM-Nav, version 1.0.67b (flight planning and LIDAR control software). All flight lines were flown with 55% side lap in order to achieve 0.30-meter nominal point spacing. The area for this delivery was covered using 43 east-west flight lines, plus two cross flights. The data from cross flights were used for final data adjustment, but are not included in the final dataset. The following are the planned LIDAR settings for acquiring the data for this project.

- Flying Height (Above Ground): 1800 meters
- Laser Pulse Rate: 70 kHz
- Mirror Scan Frequency: 62.6 Hz
- Scan Angle (+/-): 5.3°
- Side Lap: 55 %
- Ground Speed: 145 kts

LIDAR Acquisition

The LIDAR data for this delivery was acquired on October 16, 2007. The data was collected in leaf-off and minimal snow conditions. The remaining area will be acquired in 2008.

Two dual frequency GPS receivers were set up by Aero-Metric during the acquisition phase of this project. Both receivers were located at the Valdez airport, which is situated centrally in the project area. These receivers, along with the National Geodetic Service's (NGS) Continually Operating Reference Station (CORS) POT5 provided a basis for the airborne GPS/IMU (ABGPS/IMU) processing. For more information on the airborne GPS/IMU processing, see the report titled: Airborne GPS/IMU Accuracy Report for Valdez, Alaska Low Altitude LIDAR, by Aero-Metric, dated April 28, 2008.

LIDAR Processing

The raw LIDAR data was merged with the processed ABGPS/IMU data using Optech's DASHMap version 1.2. Each flight line was computed individually in LAS 1.1 format.

Final system misalignment and mirror scale corrections were computed using TerraSolid's TerraMatch version 6.005. These corrections were applied to all of the data collected in a mission. Once all of the biases were removed from the data from each mission, all of the data were combined into one dataset.

The shorelines were delineated photogrammetrically using the aerial photography collected for this project. LIDAR data in these areas were classified as water and not used for the final elevation datasets.

Using the remaining data, automated classification algorithms in TerraSolid's TerraScan, version 6.008 were used to produce the majority of the bare-earth dataset. The remainder of the data was classified using manual classification techniques.

Upon completion of the bare-earth dataset the final deliverable products were produced. Automation software created by Aero-Metric was used to produce the metadata on a per-tile basis.

LIDAR Accuracy

The final LIDAR dataset was verified using 1509 GPS surveyed ground truth points. These points were collected by Aero-Metric along the roads throughout the developed areas of the project, using Real-Time Kinematic (RTK) GPS techniques. The ground truth points were compared against the LIDAR using TerraScan, which computes the difference between each ground truth point and the LIDAR generated surface. These differences are recorded in an output file in ASCII format. This file is imported into Microsoft Excel, where a statistical analysis is performed. The full LIDAR control check analysis is included in the deliverables for this project, named Valdez_Low_Altitude_JD298A_UTM6m_G06_QC_Results.pdf.

The ground truth data is located on the delivered hard drive, in ASCII format, named Valdez_Low_QC_UTM6m_G06_PENZ.txt

For this dataset the vertical accuracy, assessed at the 95% confidence interval (1.96 x RMSE) was 0.16 meters, on hard surfaces.

Deliverables

Point Cloud Data: All returns in LAS format and American Standard Code for Information interchange (ASCII), comma delimited, Class, X, Y, Z format. The tile size is 1 km x 1 km.

Bare-Earth Processed Elevation Data (Surface Model): Derived from the bare-earth processed data is in ASCII, comma delimited format. The following are the deliverable parameters.

Grid Resolution: 0.3 meters
Bare-earth surface includes the top of water bodies' not underwater terrain.
Elevation values within open water have been flattened to the best estimate of surface water level.
The tile size is 1 km x 1 km.
Areas outside the survey boundary have been coded as NoData.

First Return Processed Elevation Data (Surface Model): Raster of the first return surface where cell heights are highest recorded value within each cell. Voids have been filled with bare-earth surface model. The following are the deliverable parameters.

Grid Resolution: 1.4 meters
The tile size is 1 km x 1 km.
Areas outside the survey boundary have been coded as NoData.

Bare-Earth Point Cloud: Data classified as bare-earth in X, Y, Z ASCII Format. The tile size is 1 km x 1 km.

Intensity Image: 1-meter resolution, 16-Bit GeoTIFF with corresponding world (*.tfw) file of the 1st return data.

Supplemental Ground Control: Ground truth data used to verify the accuracy of the LIDAR data, in ASCII comma delimited format, Point Number, Easting, Northing, Elevation. The data is in the project datum.

Airborne GPS/IMU Data: 200 Hz Smoothed Best Estimated Trajectory data for each mission flown, in binary format.

FDGC Compliant Metadata: Tile level metadata for all delivered LIDAR datasets, in .xml and .txt format.

LIDAR Index: An index depicting the tiling scheme of all the LIDAR data collected for this project. Multiple data formats were delivered: .dwg, .dxf .dgn, and .pdf.

Conclusions

The LIDAR data included in this delivery was acquired for a planned point spacing of approximately 0.30-meter. The vertical accuracy, assessed at the 95% confidence interval was 0.16 meters, on hard, open surfaces. The accuracy of the LIDAR data was not verified on all surface types, and accuracies may be degraded in areas of steep terrain or heavy vegetation.

Approximately half of the high resolution data project area is included in this delivery. The remaining tiles were not delivered due to sensor malfunctions during acquisition. The sensor has since been repaired and tested, and the remaining areas will be acquired in 2008.