Photogrammetric Survey and Map Report

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P.S.M. in responsible charge: Edward C. Beute, P.S.M. LS0005429
Title: Topographic Survey
Date of Survey (Acquisition of LiDAR) June 5-7, 2005
Subject Name: Western Seminole County Lidar Project (SI352AA)
Client: St. Johns River Water Management District
Reference Number: 2005680

Purpose:
The purpose of this survey is to provide XYZ positional information on bald earth and canopy surfaces utilizing Light Detection And Ranging (LiDAR) technology of approximately 175 square miles situated in western Seminole County, Florida and small portions of adjacent Orange and Lake counties.

Topographic Survey:
LiDAR Data Acquisition -- The Lidar data was collected utilizing an Optech ALTM (Airborne Laser Terrain Mapper) 2025 in a Cessna 208 Grand Caravan aircraft on June 5, 2005 between 0930 and 1150 hours at an altitude of 3000' AGL. Data was also collected starting June 6, 2005 at 1830 hours and ending on June 7 at 0900 hours. The configuration used a scan half-angle of +/-17 degrees, a laser pulse repetition frequency of 25 kilohertz, and a flying speed of approximately 80 knots.

Airborne GPS using a Novatel dual frequency GPS receiver was accomplished during the flight session to provide positional information for the Lidar platform. Simultaneous acquisition of ground base station data was performed using Novatel and Leica SR9500 dual frequency receivers for the June 5, 2005 session. Two Leica SR9500 dual frequency GPS receivers were used for the second session on June 6-7, 2005. Each station remained in operation for the duration of the project flight. The ground base stations were set up over National Geodetic Survey (NGS) monuments AK0205 (Designation Number I4 71 A14) and AK7045 (Designation Number GIS 0472 CAS 1). Positional information on these monuments was obtained from Data Sheets retrieved from the NGS website (http://www.ngs.noaa.gov). The GPS data from the ground base stations and the airborne platform were processed together using Applanix POSPac 4.2 software module POSGPS. All adjustments were referenced to WGS84. See processing summary files FL15605.txt, FL15705.txt, and FL15805.txt for results of the entire LiDAR flight mission.

The Inertial Measurement Unit (IMU) solution was accomplished to provide information regarding the attitude of the Lidar platform using the Applanix POSPac 4.2 software module POSProc. This solution was integrated with the Airborne GPS and adjusted using a Kalman filter in a forward/reverse solution to provide a Smoothed Best Estimate of Trajectory (SBET). Laser ranging from the airborne platform was accomplished using Realm 3.2 processing software to provide XYZ ground positions for each point.

The final horizontal values were output in Universal Transverse Mercator (UTM), Zone 17, units are meters. The horizontal datum conforms to the current Florida High Accuracy Reference Network (HARN) adjustment for the North American Datum of 1983. The Vertical Datum is the North American Vertical Datum of 1988 (NAVD88) units are feet.

Classification:
Classification of the laser data to extract above ground features such as buildings and vegetation leaving only bare earth ground points was performed using Terrasolid Ltd. Terrascan software (Version 005.007). The data was separated into five (5) separate sets of 501 files representing Bald Earth First Pulse, Bald Earth Last Pulse, Extracted Features First Pulse, Extracted Features Last Pulse, and LAS format. The Bald Earth Last Pulse best represents the natural ground and is the file upon which all accuracy statements are based. The Extracted Features First Pulse best represents the canopy data that includes all features determined to be above the natural ground.

Accuracy Statement:
Vertical Accuracy:
The LiDAR data was tested for a fundamental vertical accuracy, a supplemental vertical accuracy, and a consolidated vertical accuracy. The fundamental accuracy was tested for points that fall in open areas, not obscured by vegetation, having a normalized distribution. The supplemental accuracy testing was for points that fall in areas of vegetation, where data does not follow a normalized distribution. The consolidated accuracy was tested to determine a project wide accuracy using all surveyed points.

The fundamental vertical accuracy ($Accuracy_z$) was tested 0.6-foot vertical accuracy at 95 percent confidence level using RMSE procedures with no outliers. The vertical root mean square error (RMSEz) was tested at 0.29-foot. The fundamental vertical accuracy meets the National Standards for Spatial Data Accuracy (NSSDA) for one-foot contours. The results were determined by comparing thirty-nine (39) field surveyed points obtained on hard surface and open areas with the Bald Earth Last Return LiDAR data. Refer to file fundamental_vert_acc.xls to view the results including summary statistics, normalized distribution, and a histogram.

The supplemental vertical accuracy was tested 1.02-foot vertical accuracy at 95 percent confidence level, determined by the 95th percentile method. The results were determined by comparing 40 field-surveyed points obtained in brush and forested areas with the Bald Earth Last Return LiDAR data. . The results did not follow a normalized distribution, making the Root Mean Square Error (RMSE) methodology unsuitable for determining the accuracy of the data set; therefore, the 95th percentile method was used. Point C3 having a delta z of +1.61 feet, and point G4 having a delta z of +1.74 feet were determined to be outliers and were removed from the data set. Refer to file supplemental_vert_acc.xls to view the results including summary statistics, normalized distribution, and a histogram.

The consolidated vertical accuracy was tested 0.78-foot vertical accuracy at 95 percent confidence level, determined by the 95th percentile method. The results were determined by comparing all 79 field-surveyed points obtained in urban, open, brush and forested areas with the Bald Earth Last Return LiDAR data. The results did not follow a normalized distribution, making the Root Mean Square Error (RMSE) methodology unsuitable for determining the accuracy of the data set; therefore, the 95th percentile method was used. Point C3 having a delta z of +1.61 feet, point G4 having a delta z of +1.74 feet, point Q4 and point T4 having a delta z of –1.02 were determined to be outliers and were removed from the data set. Refer to file conslidated_vert_acc.xls to view the results including summary statistics, normalized distribution, and a histogram.

Horizontal Accuracy:
The LiDAR data was compiled to meet a 7.6-foot horizontal accuracy at 95-percent confidence level. Due to the coarse nature of the LiDAR data no comparisons could be made between the intensity returns and the horizontal positions of field surveyed points. Project planning for high resolution LiDAR data and proven system performance were used to determine the expected horizontal accuracy.

Ground Control:
Ground control surveys to verify the LiDAR survey were performed by PBS&J 482 South Keller Road, Maitland, FL 32810 under the supervision of a licensed Florida Surveyor and Mapper in accordance with Florida State Statutes. Horizontal values are referenced to the Florida High Accuracy Reference Network (HARN) adjustment for the North American Datum of 1983. Projection is Universal Transverse Mercator

(UTM), Zone 17, units are meters. Vertical values are referenced to North American Vertical Datum of 1988 (NAVD88) units are feet. GPS and conventional survey methodology was used to generate the values of the surveyed points located throughout the project area.

Aerial Cartographics of America, Inc.

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