ASPRS Research on Quantifying the Geometric Quality of Lidar Data

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The American Society for Photogrammetry and Remote Sensing's Lidar Cal/Val (calibration/validation) Working Group led by the US Geological Survey (USGS) to establish "Guidelines on Geometric Accuracy and Quality of Lidar Data" has made excellent progress via regular teleconferences and meetings. The group is focused on identifying data quality metrics and establishing a set of guidelines for quantifying the quality of lidar data. The working group has defined and agreed on lidar Data Quality Measures (DQMs) to be used for this purpose. The DQMs are envisaged as the first ever consistent way of checking lidar data. It is expected that these metrics will be used as standard methods for quantifying the geometric quality of lidar data. The goal of this article is to communicate these developments to readers and the larger geospatial community and invite them to participate in the process.

Introduction and Background

Lidar data are well on their way to becoming as important as photogrammetric imagery to geospatial analysis. However, the standards of Quality Assurance and Control (QA and QC) that transform photogrammetric imagery from a mere photograph to a metric tool are not as developed for lidar data. The current lidar data quality assessment methods are not adequate in the reporting of a) the quality of calibration of lidar system, which is an essential indicator of the overall quality of data, and b) the horizontal accuracy of the data. Recognizing this, the USGS has partnered with the ASPRS Lidar Division and the Airborne Lidar Committee to form a Calibration/Validation (Cal/Val) Working Group with a goal to promote industry-accepted guidelines and tools to help assess the quality of lidar data. The Cal/Val Working Group consists of representatives from the Government (e.g. USGS, National Geodetic Survey, National Geospatial Intelligence Agency, etc.), the industry (lidar instrument manufacturers, data providers/vendors, software developers) and academia. This paper discusses the Cal/Val Working Group's research efforts and their current status.

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The Working Group is synthesizing these efforts into a draft best practices/guidelines document (titled Guidelines on Geometric Accuracy and Quality of Lidar Data) for QA/QC processes. These efforts broadly fall under the following steps:

- Defining procedures for measuring the inter-swath goodness of fit. These procedures include defining three Data Quality Measures (DQMs)
- Suggesting the use of targets and Ground Control Points (GCPs) on natural surfaces of all slopes to measure the absolute accuracy
- Suggesting the use of sensor model based rigorous lidar system calibration methods.

These steps are encapsulated in the framework shown in Figure 1. The framework is designed such that the processes for measuring the accuracy (both inter-swath and absolute) of lidar data are independent of the data acquisition process and the sensor model of the instrument.

Among the three steps, most of the efforts of the Cal/Val Working Group have focused on defining methodologies and algorithms to measure the inter-swath goodness of fit. Existing lidar data specifications of many organizations specify requirements for inter-swath accuracy (Heidemann 2012), or ask for calibration reports or generic calibration parameters (NGS 2009; NGA 2012). However, these specifications do not detail how the testing should be done, what measurements are acceptable, etc. Therefore, there is no widely accepted standardized process of testing the inter-swath goodness of fit or accuracy of lidar data. It is expected that the ASPRS approved document will create a standard methodology of testing and quantifying the quality of lidar data, which will improve the interoperability of data from multiple sources, generating increased confidence in the data and increasing its scientific applications.