DEVELOPMENT OF THE MICROSTATION-BASED LIDAR DATA PROCESSING SOFTWARE

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ABSTRACT:

LIDAR data filtering and classification are the most important steps of the LIDAR data processing, which requires efficient data processing software. This paper introduces a new LIDAR data processing software named TopLidar. TopLidar was developed to be used on MicroStation. It makes full use of the excellent secondary development capability and efficient large amount of data management, interactive editing and dynamic 3D display of MicroStation system. In data classification, the software provides extended mathematical morphology algorithm and robust estimation algorithm and has some adaptive capability. Our testing shows that the software could be efficiently used in different terrain condition.

1. INTRODUCTION OF AIRBORNE LIDAR DATA PROCESSING

In the past 20 years, the airborne LIDAR has been extensively used as a tool for accurate and fast acquisition of ground 3D data. An airborne LIDAR system is consisted of High-Precision Position & Orientation System (POS), laser scanner, digital camera and center control unit. The POS is a key component of airborne laser detecting and measuring system. It uses Dynamic Difference Global Positioning System (DGPS) technology and Inertial Measurement Unit (IMU) to determine the position and attitude of sensor in the aerial flight. Laser Scanner is core of the LIDAR and usually consists of laser transmitter, receiver, time interval measurement device, gearing device, and a micro-processor. Digital camera is used to receive the image information of an object. The center control controls and coordinates the other hardware to ensure high levels of synchronization of all instruments (Ackerman F, 1999).

The data processing of Airborne LIDAR generally includes several steps as follow (Xiaohong Zhang, 2007):

a) Determine flight track by joint analysis of the differences of data from the ground GPS reference station and the airborne GPS data.

b) Calculate the 3D space coordinates of laser points. The software provided by equipment maker processes the GPS flight track data, airplane attitude data, ranging data measured by laser and swing angle data of laser scanning mirror and then gained 3D coordinates (X, Y, Z) data of objects called Point Cloud.

c) Filter and classify point cloud. Because of various reasons, there are some noises in the point cloud, and they must be removed by filtering. At present, most Airborne LIDAR data filtering methods are based on the height break of pin point, such as morphological filtering method (Lindenberger J, 1993), mobile windows method (Petzold B, 1999), iterative linear least squares interpolation method (Pfeifer N, 1999) and terrain slope based filtering (Vosselman G, 2000). The aim of filtering and classification is to improve the accuracy and applicability of point cloud as well as accurately distinguish information of other objects.

d) Point cloud switching: For data collection of a large area, airplane must fly multiple routes due to the limit of flight height and scanning field angle. A certain degree of overlap must be maintained and the system error should be removed as much as possible.

e) Coordinates transmission: The coordinates should be transmitted according to user's requirement.

f) Generate the digital elevation models (DEMs) and digital terrain models (DTMs) from the ground points gained after classification.

Orienteering and mosaic image data: The high-resolution images gained from digital camera are processed by aerial triangulation measurement method with internal and external orientation elements. Then the data is oriented and mosaic with the DTM data based LIDAR and form digital orthophoto maps (DOM).

2. CURRENT STATUS OF AIRBORNE LIDAR APPLICATION AND ITS DATA PROCESSING SOFTWARES

Along with technology development, LIDAR have been broadly applied. The low-altitude airborne system for shallow sea terrain measurement has been developed by the United States, Canada, Australia and Sweden. It uses airborne ranging equipment, globe positioning system and gyro stabilized platform. Its flight height is 500 to 600 m. By ranging and positioning, it finally gains the shallow sea terrain (or DEM). The United States NASA has sent Shuttle Laser Altimeter (SLA)-based space shuttle twice in 1994 and 1997 which aimed to establish database of global control points based on SLA. Then NASA proposed Geoscience Laser Altimeter System (GLAS) plan, and has launched the Cloud and Land Elevation Satellite (CESAT). The satellite has laser ranging system, GPS receiver and star tracking attitude determination system. The next step of