Oregon Department of Transportation

Stage 1 Research Problem Statement

Number*:* 25-75

Proposed Title:

Development of Methods and Guidance for Storing and Managing Statewide Mobile Lidar Data

1. Concisely describe the **transportation issue** (including problems, improvements, or untested solutions) that Oregon needs to research.

The Oregon Department of Transportation (ODOT) has collected mobile lidar on its entire highway network since 2011 on biannually basis (even years – Region 1, 2 and 3; odd years – Region 4 and 5). The return of investment (ROI) of the mobile lidar system has been demonstrated through an increasing use of the data across the agency in a variety of applications. However, with massive datasets including the trajectory, point cloud, and video log data being accumulated over years, even basic operations such as data inquiries become a bottleneck for Geometronics to address the data request due to the time-consuming manual data management workflow. Towards overcoming such challenges, ODOT has initiated a few ongoing research projects such as SPR850 and SPR866. These projects are developing prototype tools to align the mobile lidar trajectory of a data collection mission to the milepost geodatabase. By doing so, the information from both datasets (e.g., highway number, mile posts, street-side assets extracted from lidar data, road characteristics) can be correlated, which can potentially enable automated data management and efficient data query. Additionally, ODOT has recently acquired a new mobile lidar unit to increase the efficiency of covering the state highway network as well as enable more deployment for projects beyond the routine statewide coverage. However, a key complication arises from the fact that the two systems, one from Leica Geosystems and the other from Riegl, have differing data processing, export, and management procedures. Consequently, there is a pressing need to investigate the system differences and develop a workflow for reconciling the datasets obtained from both systems to improve the data management and sharing procedure to yield even higher ROIs by improving access to encourage data reuse throughout ODOT and by its partners to help fulfill ODOT's mission.

2. Document how this **transportation issue** is important to Oregon and will meet the Oregon Research Advisory Committee Priorities

Developing improved processes to manage and deliver mobile lidar data will meet the Oregon Research Advisory Committee Priorities regarding process and equipment improvements, cost reductions, and innovative technologies and systems.

Currently, mobile lidar datasets are organized based on the data collection procedure where the data files are structured in three levels, missions (the area of interest to cover), tracks (passes through the mission area), and segments (data blocks considering the file sizes). However, the data requests are usually made with the highway number and milepost range, or a geolocation, which is more intuitive for end users. Unfortunately this means that, in a lot of cases, the Geometronics team needs to search across multiple missions/tracks/segments, extract

the data files and associated information, and deliver them. Such processes are mostly manual in the current practice and can be very time-consuming. This process is prone to errors and becomes increasingly cumbersome as data archives grow over time. Additionally with the introduction of the new Riegl mobile lidar unit, new data collection procedures, data organization structures, and processing software are introduced. Therefore, the demand for Full-Time Equivalent (FTE) hours for data storage and access will increase exponentially, transferring data management into a bottleneck for achieving higher ROI of the mobile lidar system. Moreover, the efficiency for rapid data access is a key demand in some applications such as emergency response (e.g., 2020 wildfire response, Oregon Coast landslides, and future Cascadia Subduction Zone earthquake events).

The solution developed for mobile lidar data has the potential to be adopted by or extended to other data acquisition systems. For example, ODOT has recently purchased a Laserlux mobile retro-reflectometer that can efficiently measure and evaluate the reflectivity of the road markings on a moving platform. Because the system can only capture one stripe at a time, similar challenges in data management (e.g., data storage and access) need to be coped with, especially when a comprehensive evaluation and analysis involving multiple epochs and data collected from multiple lanes need to take place. Additionally, other data sources such as GNSS, terrestrial laser scanning and drone photogrammetric data can also be organized in a similar data management pipeline to enable more data reuse and applications through data fusion.

3. What **final product or information** needs to be produced to enable this research to be implemented?

The proposed research will develop a collection of prototype tools and/or scripts that ODOT can use to organize the mobile lidar data in an intuitive way including the following considerations:

- Organization of existing datasets leveraging the previous manual efforts done by ODOT.
- Development of systematic naming conventions and file structures for efficient data retrieval by scripts.
- Correlating mobile lidar data with the current highway milepost geodatabase which contains the highway and milepost information.
- Inventory with basic information of the missions/tracks/segments (e.g., date and time, data volume, highway, milepost, mileage, speed) can be consolidated for review and planning purposes.
- Data layers in TransGIS to help ODOT users know where and when data have been collected.
- Data search function based on multiple criteria including highway and milepost, as well as the user-defined area of interest.

Moreover, the research project aims to reduce user intervention by offering guidance and best practices for data collection and processing. This includes recommendations on the factors such as naming conventions and folder structure considering the software provided by the scanner manufacturers. The tools and workflow will be tested with various scenarios to demonstrate their effectiveness and efficiency. A final report will be produced to document the methodology, key findings, results and analysis, and guidance and recommendations in detail.

4. (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

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5. Other comments:

Some preliminary research has been conducted and reported in SPR850 to address the issues of correlation between the milepost geodatabase with the trajectory files from mobile lidar dataset. A basic script was developed to create an excel spreadsheet that can be queried to identify files associated with a highway section. However, those files

then need to be manually searched for and copied from their storage location. This new research would greatly improve the user interaction and automate the process of finding and copying the data to improve efficiency, expand the use of data by simplifying the process, and reduce the chance for user error mixing up or leaving out files in the copying process.

6. Corresponding Submitter's Contact Information:

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