Oregon Department of Transportation

Stage 1 Research Problem Statement

Number: 25-73

Proposed Title:

Automated Streetlight Inventory using Mobile Lidar Data

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

Poor or variable lighting conditions on roadways tend to correlate with higher crash rates. To effectively manage and evaluate lighting conditions to ensure safe conditions, a streetlight inventory is an important aspect of street-side asset management. Unfortunately, establishing such an inventory can be tedious and labor-intensive using current approaches, which often require substantial manual effort. Lidar is a remote sensing technology that can efficiently and accurately capture the geometry of a roadway and surrounding objects. ODOT currently operates a mobile lidar system to cover the entire state highway system on a regular basis which supports a wide range of applications. A wide variety of features including streetlights can be covered within a single pass of the system. Recent development of feature extraction algorithms and artificial intelligence techniques show promise for automated feature extraction from large-scale 3D point cloud data. However, most of these algorithms were neither developed nor tested with data from ODOT's mobile lidar system, having only been tested for small areas and lacking the necessity metrics or attributes for inventory purposes. Hence, the effectiveness and accuracy of these algorithms applied to ODOT's system and associated data volume remain unknown. Thus, there is a need for ODOT to implement and test some of the most-promising automated feature extraction algorithms as well as to develop a data processing pipeline to extract metrics to establish a streetlight inventory from this database.

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

The proposed project is directly aligned with the following Oregon Research Advisory Committee Priorities: **Innovative technologies and systems**, **Equity**, and **Cost reduction to asset maintenance**.

The proposed research is directly aligned with all three priority areas. First, the project utilizes innovative technologies and systems by developing a data processing pipeline and assessing several algorithms for automated streetlight extraction and localization from mobile lidar data. Furthermore, the proposed assessment of the deep learning approaches offers essential insights into Artificial Intelligence (AI) and how it can be leveraged in transportation applications. Second, the project ensures cost reduction to asset maintenance. This project will take advantage of the existing datasets that ODOT collects and manages, which will increase the Return On Investment (ROI) of the mobile lidar system. It will also enable ODOT to have adequate, up-to-date information, enabling improvement management of street light assets. Lastly, the streetlight inventory will enable a wide range of analyses to be completed systematically, which will improve equity for the under-represented communities in strategic decision-making processes. Additionally, identification and resolution of lighting issues will provide safer access to roadways, particularly for multi-modal transportation users.

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

To enable the implementation of this research, the final deliverables comprise several essential elements. Initially, the proposed project aims to annotate the mobile lidar datasets to establish a comprehensive training dataset for training and evaluating AI algorithms for extraction and classification purposes. This effort will leverage and build upon work currently underway in projects SPR850 and SPR866 in which the research team has focused on method development for road marking classification and road characterization. Next, the team will select several candidate algorithms based on their reported accuracy, scalability, availability of the source code, and other factors. They will then perform a rigorous assessment of the performance of these algorithms on ODOT's mobile lidar data. A data processing pipeline will be developed and demonstrated as a proof of concept for streetlight inventory establishment with mobile lidar data. A final report will be produced to document the methodology, testing results, analysis, and discussion in detail. It will also provide guidance of how the pipeline can be efficiently implemented to generate a statewide streetlight inventory.

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:

In another ongoing project SPR866, the research team is also exploring some methods to extract street-side asset such as pole-like objects (e.g., utility poles, traffic signs, streetlamps). However, SPR866 is primarily focused on road geometric characterization. Additionally, the scope does not include detailed classification for the pole-like objects or extraction of attributes, which would be important towards establishing a comprehensive streetlight inventory.

6. Corresponding Submitter's Contact Information:

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