Oregon Department of Transportation

Stage 1 Research Problem Statement

Number*: 25-76*

Proposed Title:

Pavement Marking Evaluation Leveraging Mobile Retroreflectometer and Mobile Lidar Systems

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

ODOT currently tracks several metrics for compliance of pavement markings, including appearance and retro-reflectivity. The Maintenance Section of ODOT routinely captures retro-reflectivity values on lane markings, which are analyzed and used in creating a plan of action for maintenance (e.g., vendor replacement if covered under warranty, or in house or contracted maintenance). Unfortunately, issues arise due to the timing and frequency of the data acquisition. ODOT recently procured a Laserlux mobile retroreflectometer that has enhanced functionality, as compared to the previous system. Specific characteristics and capabilities of the new system include both visible and NIR lasers, high-definition video recording, and auto detection of pavement markers.
Leveraging two recent ODOT research projects completed by OSU, SPR 799 (Lidar for Maintenance of Pavement Reflective Markings and Retro-Reflective Signs) and SPR 850 (Automating Lidar Data to Develop and Manage Active Transportation Asset Inventories), an opportunity exists to compare multiple systems to develop operational procedures that will enhance accuracy, reliability, efficiency and support multi-use of the data.

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**, **Safety**, and **Cost reduction to asset maintenance**.

This project has the potential to save ODOT significant money in reducing field time and effort, as well as incorporating retro-reflectivity data from multiple sources. It will lead to more cost-effective maintenance strategies and help ODOT better utilize existing warranties for road markings. The QA/QC process can also be improved using the continuous mobile coverage and reflectivity analysis, as compared with the handheld measurements for which the results are impacted by the specific locations at which measurements are taken. Improved marking maintenance strategies enable safety, financial, and environmental benefits by ensuring high-quality markings while minimizing paint and other material usage. In addition to retro reflectivity, the type of lines (e.g., broken, solid, etc.) could be determined and input into ODOT's asset management system to support future decision making. This, in turn, will facilitate improved safety evaluations, such as passing sight distance evaluations by enabling improved extraction of road geometry.

Specific research questions to be answered in this project include:

1. How do the Laserlux mobile retroreflectometer, the Delta LTL-X handheld retroreflectometer, and the Leica Pegasus:2 and Riegl VMX-2HA mobile lidar based retroreflectivity measurements compare along the dimensions of:
    a. Retroreflectivity precision and accuracy
    b. Spatial accuracy
    c. Spatial resolution of measurements
    d. Reliability across a wide range of operational procedures
    e. Data acquisition costs and efficiencies
2. How do the mobile retroreflectometer measurements vary as a function of
    a. Weather conditions (temperature, rain, fog, dust)
    b. Road geometry (e.g., slope, curvature)
    c. Vehicle speed
    d. Lighting conditions
3. Can the multiple sensors on the mobile retroreflectometer (e.g., IR scanning) supply measurements that (via various processing algorithms) can support multiple projects and programs within ODOT:
    a. Rumble strips
    b. Pavement condition

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

Anticipated final deliverables include:

1. Standard operating procedures with recommendations on how and when to use each sensor/measurement type (mobile retroreflectometer, handheld retroreflectometer, and mobile lidar) to maximize efficiency and multi-use while reducing costs and labor.
2. Algorithms and software to extract additional information from mobile retroreflectometer sensor data.

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:

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