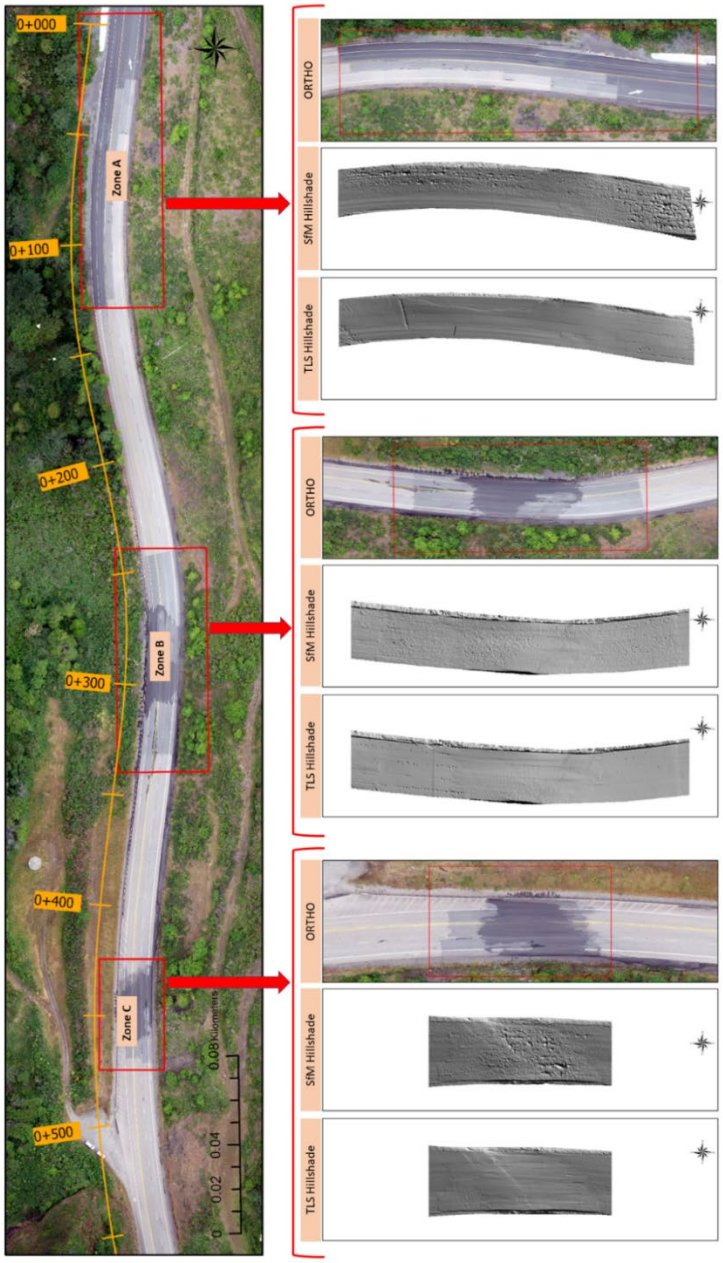
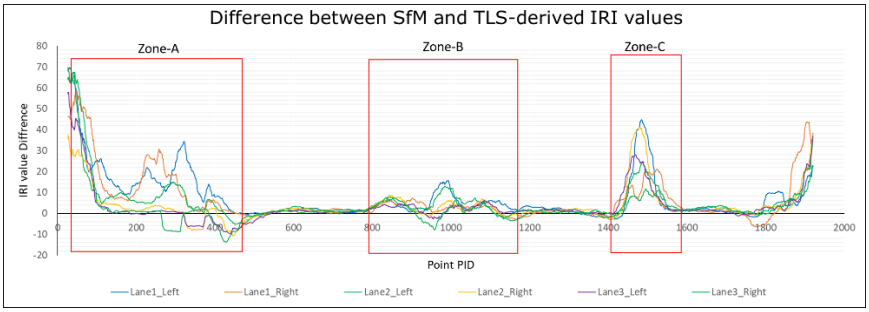
UTC Project Information	
Project Title	Assessing the Feasibility of Utilizing UAS-based Point Cloud in Pavement Smoothness/Roughness Measurement
University	Oregon State University
Principal Investigator	Ezra Che
PI Contact Information	Erzhuo.Che@oregonstate.edu
Funding Source(s) and Amounts Provided (by each agency or organization)	University of Washington PacTrans $40,00 Oregon State University $ 40,000
Total Project Cost	$80,000
Agency ID or Contract Number	69A3551747110
Start and End Dates	March 16, 2021-March 15, 2022
Brief Description of Research Project	This project will develop a framework to obtain pavement roughness metrics (e.g., IRI) from UAS acquired lidar and structure from motion point clouds, validate the viability of assessing pavement roughness using UAS-based point cloud data, and provide general guidelines for UAS data collection and processing targeting extraction of pavement information. The proposed project will help save cost and time for transportation agencies to monitor the pavement condition in certain areas by deploying UAS or re-using the UAS data have been collected on a regular basis. The anticipated outcomes include: 1) propose an end-to-end workflow that can be used for extracting IRI from UAS data; 2) develop a comprehensive accuracy assessment framework that can be used for various applications; 3) provide recommendations to transportation agencies and other groups for UAS data collection that can ensure the UAS data can be used for pavement roughness evaluation. All of these outcomes will help ensure the safety and mobility of the transportation network.

Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	This research developed a framework for collecting and processing UAS-SfM data to extract pavement information, and examined the feasibility of employing UAS-derived point clouds to evaluate pavement roughness. The team made the following highlights and recommendations based on this study: • UAS provides additional data on surrounding features, as expected from an air-based vehicle with a large field-of-view; thereby, the collected data can be used for more comprehensive analysis and other applications. • It is challenging for SfM technique to reconstruct 3D information on dark and texture-less surface such as newly paved asphalt. • Relatively small elevation derivations may have a massive effect on the IRI analysis. Localized analysis is recommended if abnormal IRI values are spotted. • The ProVAL software needs at about 20 m buffer from beginning and ending of the profile data. The research team also identified the following tasks in the future to further evaluate the use of UAS-SfM in assessing the surface roughness of the pavement: • Test if the artifacts in the UAS-SfM data can be mitigated by different flight planning and data acquisition strategy. • Compare the UAS-SfM point clouds generated from different software and settings, as well as their derivative roughness assessment results. • Investigate the impact of different DEM parameters and hole filling techniques.


0+000
0+100
0+200
0+300
0+400
0+500
Zone A
Zone B
Zone C
ORTHO
SfM Hillshade
TLS Hillshade
ORTHO
SfM Hillshade
TLS Hillshade
ORTHO
SfM Hillshade
TLS Hillshade
0
0.02
0.04
0.08


Difference between SfM and TLS-derived IRI values
Zone-A
Zone-B
Zone-C
IRI value Diffrence
Point PID
Lane1_Left
Lane1_Right
Lane2_Left
Lane2_Right
Lane3_Left
Lane3_Right

Impacts/Benefits of Implementation (actual, or anticipated)	The research team anticipated that the proposed methodology could be used to evaluate the pavement roughness in a local area, especially those are affected by geohazard such as landslide. Such methodology would significantly improve the safety and lower the cost of the data collection for assessing the pavement roughness. It can also serve as an indicator of the pavement distresses.
Web Links • Reports • Project Website	