FACT SHEET

Validating Change of Sign and Pavement Conditions and Evaluating Sign Retro-reflectivity Condition Assessment on Georgia's Interstate Highways Using 3D Sensing Technologies

PROJECT TITLE

Validating Change of Sign and Pavement Conditions and Evaluating Sign Retro-reflectivity Condition Assessment on Georgia's Interstate Highways Using 3D Sensing Technologies

STUDY TIMELINE

December 2017 - March 2020

INVESTIGATORS

Dr. Yichang (James) Tsai,
Professor,
Dr. Zhaohua Wang,
Senior Research Engineer,
Cibi Pranav,
Graduate Research Assistant,
Ryan Salameh,
Graduate Research Assistant,
Zhongyu Yang,
Graduate Research Assistant,
Georgia Institute of Technology

GDOT CHAMPIONS

Erany Robinson,
Assistant State Maintenance Engineer
Brennan Roney,
Research Engineer

For more information, please contact

Supriya Kamatkar,
Assistant Office head, Office of Performance-based Management and Research (Research)
skamatkar@dot.ga.gov

Introduction

Traffic signs are important for roadway safety and provide critical guidance to road users with traffic regulations, road hazard warnings, and other geographic information. Pavement surface distress data are critical for monitoring the statewide pavement conditions, identifying maintenance activities, and optimally allocating pavement maintenance funds. This research was focused on two objectives: a) assess and analyze the change of the traffic sign retro-reflectivity condition and b) analyze the change of pavement surface distress, using the data collected on Georgia Interstates in 2015 and 2018. LiDAR and 3D Line Laser imaging (LCMS) technologies were integrated in the Georgia Tech Sensing Vehicle (GTSV) (Figure 1) to collect the traffic sign and pavement data simultaneously.

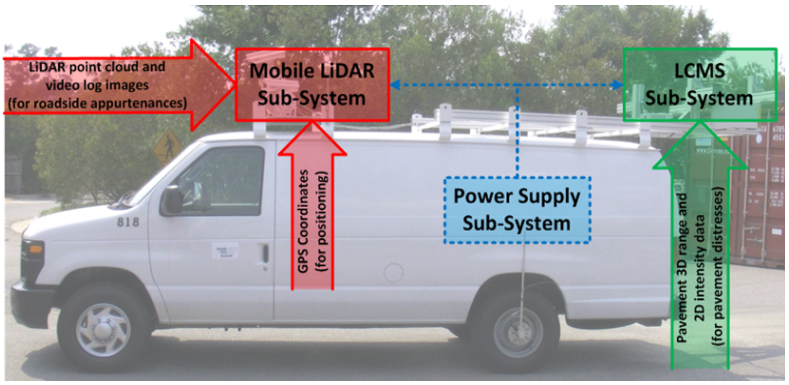

Figure 1. Georgia Tech Sensing Vehicle integrating LiDAR sub-system and 3D line laser imaging (LCMS) sub-system

Methodology

- This project developed a new categorical traffic sign retro-reflectivity condition assessment method using mobile LiDAR and video images and validated the developed method with a GDOT inspector's field assessment. The developed method has been applied successfully as a pilot to assess and categorize sign retro-reflectivity conditions (good, poor, and uncertain) of 338 selected ground mounted signs along 63 miles of I-285 in one direction (Figure 2). In addition, the change of sign retro-intensity was also analyzed using 4 years of LiDAR data collected on I-285 (Figure 3).
- To analyze the change of pavement surface distresses, the asphalt pavement condition evaluation data on the entire Georgia's interstate highways were collected in 2018 and compared with the pavement distress data collected in 2015 (GDOT RP 15-11: Implementation of Automatic Sign Inventory and Pavement Condition Evaluation on Georgia's Interstate Highways) to analyze the change/deterioration of pavement distresses. The International Roughness Index (IRI) data and the pavement distresses of Jointed Plain Concrete Pavement (JPCP) on interstate highway were also collected and analyzed in this project using the 3D pavement surface data, automatic pavement distress detection, and slab-base severity level classification.

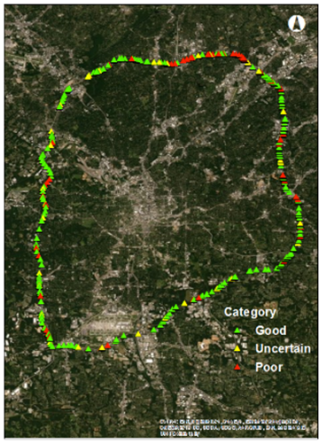

Figure 2. Signs in good, uncertain, and poor retro-reflectivity condition on GA I-285 based on the LiDAR

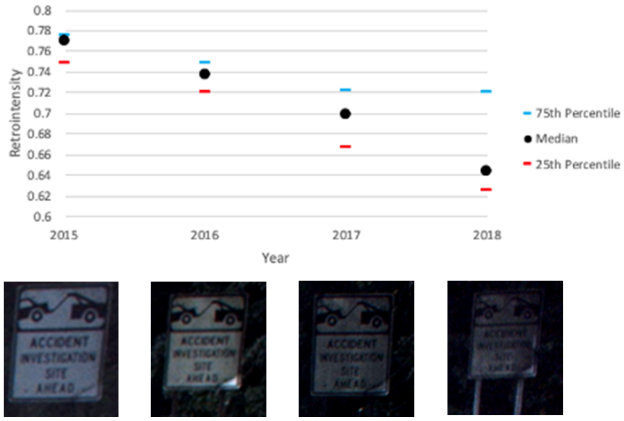

Figure 3: Retro-intensity deterioration trends from 2015 to 2018 for a white sign on GA I-285.

Conclusions

- Among 338 selected signs assessed on the I-285, 67% of the signs were classified in a good retro-reflectivity condition, and 33% of the signs were classified in a "poor" or "uncertain" retro-reflectivity condition using new categorical traffic sign retro-reflectivity condition assessment method that could potentially save 60% of sign inspection effort and can be implemented practically.
- Based on the 4 years retro-intensity deterioration analysis, promising trends for LiDAR retro-intensity change can be observed for the traffic signs. This can be used to further establish a forecasting model for sign replacement planning.
- Automatic pavement condition evaluation using 3D line laser imaging technologies has demonstrated to be accurate, reliable and consistent for not only detection and measurement of asphalt pavement distresses but also JPCP distresses and IRI through the data collected on the entire Georgia's Interstates in 2015 and 2018.

Potential Impacts and Benefits

- The developed categorical traffic sign retro-reflectivity condition assessment method using mobile LiDAR can complement commonly used night time retro-reflectivity sign condition assessment methods and could potentially save approximately 60% of sign inspection efforts at the network-level by focusing on signs that need the most attention (poor or uncertain category signs), and quickly and efficiently identify poor retro-reflectivity condition signs for timely replacement.
- The long-term retro-intensity change trends will help transportation agencies to understand the long-term deterioration behavior of the sign retro-intensity and predict the optimal timing for sign replacement.
- 3D sensing technologies have demonstrated to be consistent, reliable, and cost-effective. This impacts GDOT's decision making to adapt 3D laser technology for its automatic pavement condition evaluation.
- As an added benefit, the automated methods for collecting sign and pavement data enhance safety by eliminating workers' exposure to roadway hazards.