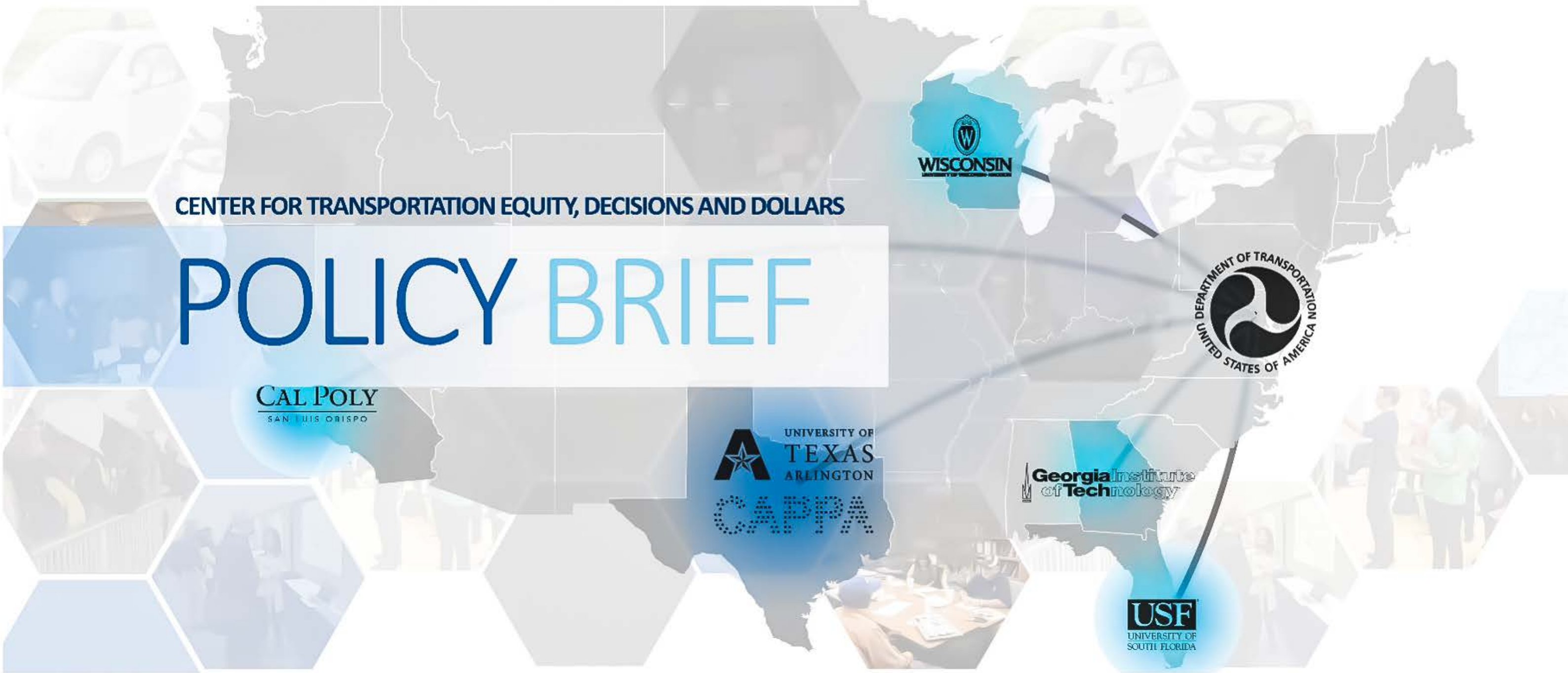

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Evaluation of Cost-Effective Pavement Deformation Detection Technologies using LiDAR

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Executive Summary:

Cross slope, the transverse slope with respect to the horizon, is a critical geometric feature of pavement surfaces as it affects safety due to its relationship to the potential of hydroplaning during wet weather. Appropriate cross slopes provide adequate drainage so water will run off the surface to a drainage system such as street gutters (urban streets) or side ditches (rural facilities). An inadequate cross slope could lead to several safety issues, including hydroplaning, loss of control, and run-off-road crashes. This research study compared two methods of data collection, namely a conventional survey and a LiDAR-based survey using a terrestrial laser scanner, to evaluate the roadway surface's cross slopes. Two existing rural farm road segments in San Luis Obispo County (California, USA) were selected for evaluation. A comparison between the results from the two methods showed that the difference follows a normal distribution, indicating no systematic errors during data collection. Also, the two-sided paired t-test between the traditional survey surveying and LiDAR showed no statistically significant differences between the slopes estimated using the two methods. This finding is important since LiDAR could increase the data collection efficiency and support the asset management practices of smaller county agencies. Moreover, the results indicate that the difference between LiDAR-derived cross slopes and field surveying measurements is less than 0.2% at a 95% confidence level. This level of accuracy meets cross-slope accuracy requirements (±0.2%) used by practitioners and demonstrates that LiDAR is a reliable method for cross-slope data collection.

Scope of Problem:

The cross slope is normally calculated by dividing the difference in elevation between the two edges of the travel lane by the lane width. Agencies require the elevation data for the edge of each travel lane at 100-ft stations in tangents and 50-ft stations on curves to estimate cross slope. These requirements make conventional methods to evaluate pavement cross slopes for existing roadways very time-consuming and require the closure of lanes for which the cross slope is measured. While exploratory research using LiDAR has been used to extract several road features, such as cross slopes and road markings, on an experimental basis, these methods are still not fully implemented by the local and regional agencies that are most in need of cost savings that come with the use of these systems.

Methods:

This research demonstrated the process of cross-slope estimation on rural farm roads in San Luis Obispo county California. The research used both the conventional survey as well as a LiDAR-based technology in collaboration with our agency stakeholders.

Policy Recommendations:

The cross slope estimated using the two methods had so statistically significant difference. LiDAR-based cross-slope estimation should therefore be integrated into local/regional agency's asset management programs to improve the efficiency and efficacy of these programs. Automating the analysis for manual extraction of data is tedious; automating those processes can improve cost-effectiveness. Therefore, automated/semi-automated techniques for filtering, segmentation, and classification of point clouds to extract roadway objects are desirable. As data processing and computing capabilities expand, commercial software product space in the area of automated extraction of information from LiDAR point clouds is worth watching.

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