PROJECT SUMMARY REPORT

0-7098: Determine Drainage Basin Mapping and Estimation of Hydroplaning Potential

Background

Hydroplaning occurs because of a series of unfortunate events that results from a combination of driver behavior, vehicle characteristics, and roadway features. Surface geometry and roadway texture are two variables within the control of the managing agency.

The purpose of this project was to use mobile light detecting and ranging (LiDAR) measurements to measure surface geometry to map drainage basins on the pavement surface. Mobile LiDAR was used to collect measurements at highway speeds. Using mobile LiDAR technology fostered safety during data collection and provided a dense dataset over the roadway. The ability to use mobile LiDAR to measure drainage basins along the roadway surface was identified in a previous Texas Department of Transportation (TxDOT) study, Developing a Surface Drainage Rating for Inclusion in TxDOT's Asset Management System.

What the Researchers Did

Researchers used I-20 in the TxDOT Atlanta District as an initial study location. Mobile LiDAR data were collected along this portion of I-20, after which researchers processed and analyzed the data through multiple computer programs.

Ultimately, critical drainage basins along I-20 were mapped using a .kml file in Google Earth. The use of Google Earth allowed the transmission of the results to the end users and allowed decision-making personnel to easily navigate from one critical drainage basin to another. The shortcoming of the initial process was the multiple steps and programs required to generate useful results.

After demonstrating that the process was viable on I-20 in the Atlanta District, researchers began developing a single software tool to complete the entire process. Within this tool, mobile LiDAR data are visualized, processed, and analyzed. Using analyzed data, calculations are performed that result in the creation of .kml files with critical drainage basins. The new software tool was tested on sections in the TxDOT Tyler and Lufkin Districts.

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What They Found

This study found that mobile LiDAR serves as a safe and effective tool to collect surface data on large networks of interest for agencies. Analyzing surface measurements led to mapping drainage basins and effectively identifying hydroplaning-vulnerable locations. Because the geometry contributes to the vulnerability of these locations, the managing agency must determine the appropriate mitigation technique.

For many instances where the geometry serves as the contributing factor, it cannot be easily or economically modified. For example, modifying the geometry of I-20 in the TxDOT Atlanta District was not feasible, but because this project identified specific locations, the district was able to develop a targeted mitigation approach. Specifically, the district developed a spot location permeable friction course project to address the vulnerable locations.

Researchers also found that it was possible the store LiDAR data in a single program where the analysis could occur without moving data and output across several platforms. This means that using this tool in the future will allow researchers to provide results quickly and on extensive roadway networks.

What This Means

The tools developed as part of this study have reached a maturity level to begin statewide implementation. This was the second research project to use mobile LiDAR measurements to perform this type of analysis. The first project identified this capability. In the current project, researchers validated the ability of the technology to acquire the data and tested the analysis procedures to ensure accurate output.

The new software tool developed through this study means that TxDOT now has a deployable tool to assist decision makers with safety decisions. Specifically, this tool can help districts prioritize needs for the wet-weather accident reduction program.

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