CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY

Texas Department of Transportation

0-6878: Accelerating Innovation in Partnered Pavement Preservation

Background

Knowledge of the surface characteristics of highway pavements is essential for state departments of transportation (DOTs) to maintain a safe, comfortable, and durable highway system. A certain level of friction at the pavement surface is essential to provide safe driving conditions, particularly during wet weather. However, the measurement of friction at a network level is a challenging task. Practical limitations of the testing equipment makes the collection of skid data highly inefficient. There is a strong correlation between pavement texture and friction. Accordingly, measuring texture is of prime interest because of its safety connotations. Currently, most state DOTs rely on subjective measurements of texture that are not reliable. Recent advancements in laser technologies made it possible to efficiently and accurately measure pavement texture at the macro and micro levels.

What the Researchers Did

During this research project, the researchers developed a linear laser scanner (LLS) for the accurate characterization of the macro- and micro-texture of pavement surfaces. This system has the advantage of capturing three-dimensional (3D) data on pavement surfaces using an automatic, simple, and quick operation. The system was developed using off-the-shelf commercially available components and can be operated in the laboratory and in the field. The successful development of this system enabled the researchers to apply it beyond its original intended use. First, the prototype was evaluated in terms of its ability to capture macro- and micro-texture. Secondly, because it is capable of capturing a high-definition 3D image of the pavement surface, the researchers developed a procedure to measure the mean texture depth (MTD). Finally, the researchers evaluated the relationship between pavement texture and pavement friction.

What They Found

Based on statistical analyses of the power spectral density (PSD), the LLS is capable of differentiating aggregates of different micro-texture in a consistent and objective way in the first decade of the micro-texture (50–500 microns). Due to the limitations of the laser utilized, the LLS could not differentiate the second decade of the micro-texture. Furthermore, at the macro-texture level, neither of the aggregates were statistically different (as expected, since their sizes were comparable). The results of PSD, root mean square roughness, and the depth of surface

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smoothness were consistent with the Surface Aggregate Classification (SAC) provided by TxDOT.

The LLS was also used to scan numerous pavement surfaces of different textures and to calculate the MTD based on the 3D representation of the surface. The repeatability and variability of the developed MTD algorithm were compared to those of the Sand Patch Test (SPT). The results proved the high repeatability of the LLS. While the coefficient of variation of the SPT was in the order of 8%, the coefficient of variation of the LLS was 0.03%. Additional advantages of the LLS include higher testing speeds and larger coverage areas. Using the LLS, larger representative sections of the road can be assessed very rapidly. This approach both increases the efficiency of assessing the pavement texture and provides a better understanding of the pavement surface texture.

During this study, the LLS prototype was also used to measure mean profile depth (MPD) and compare it to the MPD measure indicated by the Circular Track Meter (CTM). Pavement friction was measured with the Dynamic Friction Tester (DFT) and Grip-Tester. Once again, the results of the repeatability analysis demonstrated the reliability of the LLS for pavement texture measurements. The MPD calculated with the LLS was similar to that calculated with the CTM.

Regardless of the test speed and pavement type, the friction number obtained by the Grip-Tester showed a strong linear correlation with DFT measurements. Due to the reliable results obtained with the Grip-Tester and the lack of need to control traffic, the use of the LLS is recommended over the DFT. The statistical analysis showed a strong positive linear correlation between texture and friction in pavements.

What This Means

Although the LLS was developed to characterize aggregate macro- and micro-texture, this research project demonstrated that the development of the LLS had impacts well-beyond those intended in the original technical objectives of the project. For example, the LLS is capable of consistently differentiating aggregates at the micro-texture levels; therefore, including micro-texture measurements in the SAC is recommended to assess the potential frictional properties of the aggregate. In addition to using the LLS, larger representative sections of the pavement surface can be assessed to determine texture for quality control/quality assurance activities. This dual-pronged approach both increases the efficiency of assessing pavement texture and provides a better characterization. Finally, the LLS can also be used for other applications, such as a more objective approach to design of seal coats.

For More Information

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