Project Summary

Texas Department of Transportation

0-4463: Using Profile Measurements to Locate and Measure Grind and Fill Areas to Improve Pavement Ride

Background

Good ride quality, proper cross slope, and accurate material estimates are important for an overlay project. Currently there is not a method in Texas to accurately relate the condition of an existing roadway to the potential benefits of different overlay and milling strategies during the design phase or provide the appropriate information to the contractor. Many districts have requested the use of the Texas Department of Transportation (TxDOT) inertial profilers to locate and measure potential grind and fill areas on paving projects prior to overlays. The TxDOT districts want to use a high-speed accurate instrument to survey the existing roadway without disrupting traffic. This research develops a method that can integrate data from a scanning laser or multi-path profiles with a gyroscope and inertial profiler for viewing three-dimensional pavement surfaces for overlay and milling strategies.

What the Researchers Did

The original objective of this project was to investigate the integration of the scanning laser system, the inertial profiler, and the gyroscope for overlay and milling strategies. The lack of adequate scanning laser data prevented the expected progress in achieving this goal; however, a number of very useful results were achieved. The results include:

(1) A procedure was developed for using the gyroscope sensor in the current TxDOT profilers for providing a cross-slope capability. The TxDOT WinTK data collection program, developed by the University of Texas at Arlington, was modified so that these readings could be synchronized and obtained directly with the inertial reference profile readings. Then by integrating the cross-slope measurements with the profile, most of the effects of the vehicle body on the gyroscope measurements can be removed.

(2) Three-dimensional (3-D) surface software was developed that synchronizes the profile and gyroscope data with transverse profile data to provide a pavement surface image. This provides a useful package or analysis tool for 3-D surface profile investigations. The transformed data can be sent to a grind and fill module developed in the project for modeling the results of different overlay strategies. The software is compliant with the TxDOT in-house VNET protocol and reads the profile, gyroscope, and transverse profile sensor data directly from the VNET PF9 files.

Research Performed by:

The University of Texas at Arlington (UTA)

Texas Transportation Institute (TTI),
The Texas A&M University System

Research Supervisor:
Roger S. Walker, UTA

Researchers:
Eric Becker, UTA
Emmanuel Fernando, TTI
Wenting Liu, TTI

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(3) In a project conducted by The University of Texas at Austin in the early 1980s, researchers developed a computer program to simulate the change in surface profile with successive overlay lifts.
This program, OVERLAY, was recoded, modified, and updated for current instrumentation and modeling methods for verification using measured data taken during construction of a test site at the Texas A&M Riverside Campus.
(4) A Compax3 linear actuator or static scanning laser system was developed and tested on a constructed test site with varying levels of rutting.

What They Found

The gyroscope was found to provide pavement cross-slope information at highway speeds. When the sensor data is integrated with longitudinal and transverse profile, it can be used for providing a three-dimensional display of the pavement surface. With an accurate 3-D surface display it was possible to develop a module for computing grind and fill quantities.

In evaluating the program OVERLAY, the following were noted:
(1) The predicted profiles from OVERLAY exhibit frequency contents that are appreciably different from the measured reference profiles.
(2) Differences in the frequency contents between predicted and measured profiles result in much lower predicted IRIs from the program compared to the corresponding statistics computed from the reference profiles.
(3) The simulation of overlay profiles based on the methodology used in OVERLAY needs to be based on unfiltered or true reference profiles.
(4) Relative to the original compaction model, the sigmoidal model generally gave predictions of the overlay profile that are closer to the corresponding reference profiles. However, both methods significantly under-predict the IRI.

The Compax3 linear actuator or static scanning laser system accurately measured the rut depth.

What This Means

With proper implementation of research results, districts can use their high-speed profilers to provide three-dimensional surface measurements. The research develops a program method, which when implemented and verified can integrate data from a scanning laser or multi-path transverse displacements with gyroscope and inertial profile data for three-dimensional pavement surfaces measurements. The transformed data can be sent to a grind and fill module developed in the project, for modeling different overlay strategies. If implemented, the linear actuator or static scanning laser system can potentially provide very accurate transverse surface measurements.

For More Information:
Research Engineer - German Claros, TxDOT, 512-465-7403
Project Director - Brian Michalk, TxDOT, 512-467-3935
Research Supervisor - Roger S. Walker, UTA, 817-272-3640

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Texas Department of Transportation
Research and Technology Implementation Office
P.O. Box 5080
Austin, Texas 78763-5080
512-465-7403