Abstract

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Thesis title: **Investigating the Measurement Variability of International Roughness Index Estimates from LiDAR- based 3D Pavement Profiling**

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The increase in access to three-dimensional pavement profiles has presented an opportunity to estimate pavement roughness from a combination of multiple longitudinal profiles to help mitigate the effects of path wandering. However, existing 3D pavement profiling technologies, such as line lasers-with-imaging and light detection and ranging (LiDAR), have been primarily deployed and critiqued for reliable estimation of cracks and transverse rut depth measurements. Their utility in roughness measurements has remained exploratory given the prevailing practice of estimating the international roughness index (IRI) from longitudinal profiles sampled along wheel paths. This study presents an investigation into the variability of IRI measurements obtained from three-dimensional scanning of the pavement profile from a 2D LiDAR scanning the road environment as the network survey vehicle (NSV) moves in the longitudinal direction. The proposed study design sought to investigate the impact of sampling variability within the longitudinal profiles on IRI estimation by systematically changing the vehicle operating speed. The controlled field experiments demonstrated a persistent linear association between IRI estimates derived from LiDAR when compared with the inertial profiler estimates, although there existed a systematic bias between the two sets of measurements. The analysis also observed a significant effect of the NSV's operating speed on the longitudinal sampling interval within

the point cloud as well as IRI measurements. The study reiterates the presence of lateral variability in IRI estimation. Thus, leveraging multiple longitudinal profiles from 3D measurements presents a valuable opportunity with an emerging need to investigate the repeatability and accuracy of 3D profilers.