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An approach to integrate GPR thickness variability and roughness level into pavement performance evaluation

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It is a truism that pavements deteriorate due to the combined effects of traffic loads and environmental conditions. The manner or ability of a road to meet the demands of traffic and the environment and to provide at least an acceptable level of performance to road users throughout its life is referred to as pavement performance. An important indicator of pavement performance is ride quality. This is a rather subjective measure of performance that depends on (i) the physical properties of the pavement surface, (ii) the mechanical properties of the vehicle, and (iii) the acceptance of the perceived ride quality by road users. Due to the subjectivity of ride quality assessment, many researchers have worked in the past to develop an objective indicator of pavement quality. The International Roughness Index (IRI) is considered a good indicator of pavement performance in terms of road roughness. It was developed to be linear, transferable, and stable over time and is based on the concept of a true longitudinal profile. Following the identification and quantification of ride quality by the IRI, pavement activities include the systematic collection of roughness data in the form of the IRI using advanced laser profilers, either to "accept" an as-built pavement or to monitor and evaluate the functional condition of an in-service pavement.

On the other hand, pavement performance can vary significantly due to variations in layer thickness, primarily due to the construction process and quality control methods used. Even if a uniform design thickness is specified for a road section, the actual thickness may vary. It is expected that the layer thickness will have some probability distribution, with the highest density being around the target thickness. Information on layer thickness is usually obtained from as-built records, from coring or from Ground Penetrating Radar (GPR) surveys. GPR is a powerful measurement system that provides pavement thickness estimates with excellent data coverage at travel speeds. It can significantly improve pavement structure estimates compared to data from as-built plans. In addition, GPR surveys are fast, cost effective, and non-destructive compared to coring.

The present research developed a sensing approach that extends the capability of GPR beyond its ability to estimate pavement thickness. Specifically, the approach links GPR thickness to IRI based on the principle that a GPR system and a laser profiler are independent sensors that can be combined to provide a more complete image of pavement performance. To this end, field data collected by a GPR system and a laser profiler along highway sections are analyzed to evaluate

pavement performance and predict future condition. The results show that thickness variations are related to roughness levels and specify the deterioration of the pavement throughout its lifetime.