EGU22-4914
https://doi.org/10.5194/egusphere-egu22-4914
EGU General Assembly 2022

Sensing roadway surfaces for a non-destructive assessment of pavement damage potential

Konstantinos Gkyrtis, Andreas Loizos, and Christina Plati
National Technical University of Athens (NTUA), School of Civil Engineering, Department of Transportation Planning and Engineering, Greece (gkyrtis@central.ntua.gr)

Modern roadways provide road users with both a comfortable and safe ride to their destinations. Increases in traffic demands and maximum allowable loads imply that roadway authorities should also care for the structural soundness of pavements. In parallel, budgetary limitations and frequent road closures for rehabilitation activities, especially in heavy-duty motorways, might guide the related authorities to focus their strategies on the preservation of pavements functional performance. However, structural issues concerning pavement damage remain on the forefront, as pavement's service life extends beyond its design life; thus structural condition assessment is required to ensure pavement sustainability in the long-term.

Non-Destructive Testing (NDT) has played a major role during condition monitoring and evaluation of rehabilitation needs. Together with input from visual inspections and/or sample destructive testing (e.g. coring), NDT data help to define indicators and threshold values that assist the related decision-making for pavement condition assessment. The most indicative tool for structural evaluation is the Falling Weight Deflectometer (FWD) that senses roadway surfaces through geophones recording load-induced deflections at various locations. Additional geophysical inspection data with the Ground Penetrating Radar (GRP) is used to estimate pavement's stratigraphy. Integrating the above sensing data enables the estimation of pavement's performance and its damage potential.

To this end, a major challenge that pavement engineers face, concerns the assumptions made about the mechanical characterization of pavement materials. Asphalt mixtures, located on the upper pavement layers, behave in a viscoelastic mode because of temperature- and loading frequency- dependency, whereas in the contrary, simplified assumptions for linear elastic materials are most commonly made during the conventional NDT analysis. In this research, an integration of mainly NDT data and sample data from cores extracted in-situ is followed to comparatively estimate the long-term pavement performance through internationally calibrated damage models considering different assumptions for asphalt materials. Two damage modes are considered including bottom-up and top-down fatigue cracks that are conceptually perceived as

alligator cracks and longitudinal cracks respectively alongside a roadway's surface. As part of an ongoing research for the long-term pavement condition monitoring, data from a new pavement was considered at this stage indicating a promising capability of NDT data towards damage assessment.

Overall, this study aims to demonstrate the power of pavement sensing data towards structural health monitoring of roadways pinpointing the significance of database development for a rational management throughout a roadway's service life. Furthermore, data from limited destructive testing enriches the pavement evaluation processes with purely mechanistic perspectives thereby paving the way for developing integrated protocols with improved accuracy for site investigations, especially at project-level analysis, where rehabilitation design becomes critical.