EGU22-1849, updated on 14 Aug 2022
https://doi.org/10.5194/egusphere-egu22-1849
EGU General Assembly 2022

On the use of Artificial Intelligence for classification of road pavements based on mechanical properties using ground-penetrating radar and deflection-based non-destructive testing data

Fateme Dinmohammadi[1], Luca Bianchini Ciampoli[2], Fabio Tosti[1], Andrea Benedetto[2], and Amir M. Alani[1]

[1]University of West London, School of Computing & Engineering, United Kingdom of Great Britain – England, Scotland, Wales (fateme.dinmohammadi@uwl.ac.uk)

[2]Department of Engineering, Roma Tre University, Rome, Italy

Road pavements play a crucial role in the development of any construction as they provide safe surface on which vehicles can travel comfortably [1]. Pavements are multi-layered structures of processed and compacted materials in different thicknesses and in both unbound and bound forms with the function of supporting vehicle loads as well as providing a smooth riding quality. The condition of road pavement structures is susceptible to the impact of uncertain environmental factors and traffic loads, resulting in pavement deterioration over time. Therefore, the mechanical properties of pavements (such as strength, stiffness, etc.) need to be monitored on a regular basis to make sure that the pavement condition meets its prescribed threshold. The ground-penetrating radar (GPR) and deflection-based methods (e.g., the falling weight deflectometer (FWD)) are the most popular non-destructive testing (NDT) methods in pavement engineering science that are often used in combination to evaluate the damage and strength of pavements [2-4]. The layer thickness data from GPR scans are used as an input for deflection-based measurements to back-calculate the elastic moduli of the layers [2]. During the recent years, problems concerning the automatic interpretation of data from NDTs have received good attention and have simulated peer to peer interests in many industries like transportation. The use of Artificial Intelligence (AI) and Machine Learning (ML) techniques for the interpretation of NDT data can offer many advantages such as the improved speed and accuracy of analysis, especially for large-volume datasets. This study aims to train a dataset collected from GPR (2 GHz horn antenna) and the Curviameter deflection-based equipment using AI and ML algorithms to classify road flexible pavements based on their mechanical properties. Curviameter data are used as ground-truth measurements of pavement stiffness, whereas the GPR data provide geometric and physical attributes of the pavement structure. Several methods such as support vector machine (SVM), artificial neural network (ANN), and k nearest neighbours (KNN) are proposed and their performance in terms of accuracy of estimation of the strength and deformation properties of pavement layers are compared with each other as well as with the classical statistical methods. The results of this study can help road maintenance officials to identify and prioritise pavements

at risk and make cost-effective and informed decisions for maintenance.

References

[1] Tosti, F., Bianchini Ciampoli, L., D'Amico, F. and Alani, A.M. (2019). Advances in the prediction of the bearing capacity of road flexible pavements using GPR. In: 10th International Workshop on Advanced GPR, European Association of Geoscientists & Engineers, pages 1-5.

[2] Plati, C., Loizos, A. & Gkyrtis, K. Assessment of Modern Roadways Using Non-destructive Geophysical Surveying Techniques. Surv Geophys 41, 395–430 (2020).

[3] A. Benedetto, F. Tosti, Inferring bearing ratio of unbound materials from dielectric properties using GPR, in: Proceedings of the 2013 Airfield and Highway Pavement Conference: Sustainable and Efficient Pavements, June 2013, pp. 1336–1347.

[4] Tosti, F., Bianchini Ciampoli, L., D'Amico, F., Alani, A.M., Benedetto, A. (2018). An experimental-based model for the assessment of the mechanical properties of road pavements using GPR. Construction and Building Materials, Volume 165, pp. 966-974.