

Using Machine Learning to Identify the Most Critical Factors Affecting Maintenance of Tunnels

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ABSTRACT

Having well-maintained transportation infrastructure systems, including tunnels, is essential for the functioning and growth of the US economy. As such, monitoring the condition of tunnels through structural evaluation and inspections is essential to maintain their level of service. However, there is a lack of research that utilizes data from previous formal inspections to model and understand the condition of tunnels in the US. Being the case, this paper tackles this research need by developing a tunnel condition rating model that identifies the most critical factors affecting maintenance of tunnels. To this end, the authors utilize Random Forest (RF) which is a well-proven machine learning technique. RF is able to both identify the importance of features and utilize the selected features to accurately predict the condition rating of tunnels. The model is trained using data for tunnels in the US, from the Federal Highway Administration Agency (FHWA). Validation, testing, and hyperparameter tuning of the model are performed through a k-fold cross validation combined with a grid search algorithm. Results highlight the most critical features affecting maintenance of tunnels. In addition, the RF prediction model yields a satisfactory accuracy of more than 85%. Ultimately, the developed tunnel condition rating model can benefit transportation entities in understanding and predicting the condition rating of tunnels in the US; hence, optimizing and prioritizing their maintenance plans.