MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

RESEARCH SUMMARY

IMPLEMENTING MACHINE LEARNING WITH HIGHWAY DATASETS

WHAT WAS THE NEED?

Every year the Maryland Department of Transportation (MDOT) invests millions of dollars into testing geomaterials, digitizing historic records and capturing infrastructure inventory and condition data. Massive amounts of tabular data, documentation, and imagery, which are relevant for planning and engineering purposes, continue to be accumulated. These datasets provide an excellent opportunity for establishing machine learning models to enable reliable data analysis and prediction of engineering characteristics. Improved cost effectiveness of the agency can be achieved by enhancing analysis capabilities and improving decision-making by incorporating machine-learning into planning and engineering work processes.

WHAT WAS THE GOAL?

By building on MDOT SHA initial development of drilling data neural network models, this project optimized and updated the existing machine learning models with newly available data and developed and tested new machine learning models for datasets of interest including drilling and pavement data, project duration and highway right-of-way image datasets.

WHAT DID THE RESEARCH TEAM DO?

Various machine learning models were developed and trained for the selected highway datasets including drilling data, pavement falling

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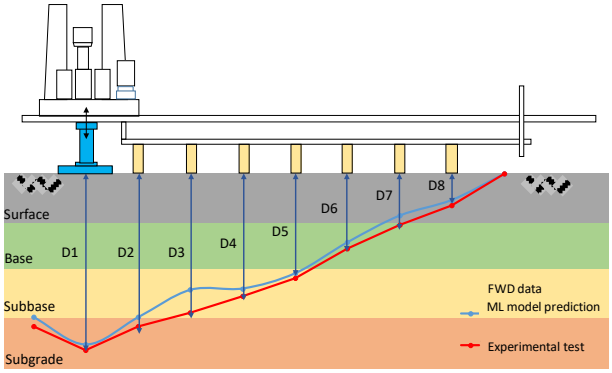
weight deflectometer (FWD) data, scheduling estimates using reinforcement learning, right-of-way (ROW) image processing and object detection for three types of image objects, and pavement core thickness datasets. Tabular data neural network models for drilling data and pavement data were trained and used for dependent variable prediction. A state-of-art object detection model using YOLO v3 algorithm were also trained and tested for detecting traffic barrier end treatments and insect blocking in ROW images. Data preparation including bounding box creation and labeling and converting image data into a format suitable for YOLO v3 model was conducted. The YOLO v3 spp model in detecting the three objects of interest in this study have shown high detection rates for the test image datasets.



Reinforcement learning models for drilling project schedule estimation were developed and tested using historical data records. Furthermore, random forest model was also trained and tested for one type of drilling data – groundwater depth.

WHAT WAS THE OUTCOME?

Data-driven machine learning models that can be used to represent a variety of highway datasets such as drilling and pavement data, construction history/pavement thickness data, object detection in images and drilling project schedule estimation has been investigated and their prediction performance were tested for validity. Four types of machine learning algorithms were studied, including neural network model for tabular data, deep learning-based object detection model, reinforcement learning and random forest models for different applications. Some of the machine learning models such as those trained for drilling data, pavement FWD data, and pavement core thickness data from this project have already been integrated with existing work processes in MDOT SHA.

HOW WILL MDOT SHA USE THE RESULTS?

These machine learning models can potentially be used to assist with the decision-making process in project planning and construction and some of these models have been integrated with existing working process in MDOT SHA. Improved cost effectiveness of the agency can be achieved by enhancing analysis capabilities and improving decision-making through incorporating machine-learning into planning and engineering work processes.

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