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Caltrans Division of Research, Innovation and System Information

Research Notes

Potential for Advanced Image Evaluation in APCS

Potential for Advanced Image Evaluation in Automated Pavement Condition Surveys

Pavement

MARCH 2022

Project Title:
Potential for Advanced Image Evaluation in APCS

Task Number: 3766

Start Date: September 1, 2021

Completion Date: September 30, 2023

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WHAT IS THE NEED?

Over the past decade, Caltrans has adopted an Automated Pavement Condition Survey (APCS), which collects data at highway-speeds using cameras, lasers, and other instruments. Even within this period, the available APCS technologies have advanced rapidly, especially in the capabilities of so-called "3D images" of the pavement surface, enabling better and more reliable condition assessment.

In the same time frame, there have been massive advances outside of the pavement community in image analysis, particularly using deep learning techniques, which are often referred to as Artificial Intelligence (AI). The impacts of these advances are all around us, such as facial recognition and tagging, self-driving cars, robots, and many other modern marvels. Some researchers have used these techniques in pavement engineering, and the various APCS vendors and researchers are investigating their use for improved automation crack detection and other condition ratings, compounding the advances in APCS technology even further.

However, the current research focuses on traditional condition measures, like cracking, while many of the uses of deep learning outside of pavements are using the techniques for much more advanced applications. This project will investigate the use of deep learning to extract more complex information from the APCS data, such as whether pumping of fines is occurring, an individual slab has been replaced, identification of patches, or if the drainage is adequate. These types of higher-level engineering questions about a pavement section are often critical in determining the causes of distress and what treatments are appropriate. In addition, other roadside issues might be considered. Many other properties could be evaluated, but this project is intended to explore the use and feasibility of these technologies and to encourage vendors to adopt these methodologies if they are practical and beneficial.

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Georgia Tech is one of the APCS research groups with considerable experience in deep learning, and so they were invited to partner with UCPRC.

WHAT ARE WE DOING?

The potential for advanced image analysis will be accomplished through the following tasks,

Task 1: Capacity development at UCPRC, including background and establishment of a knowledge and computing environment suitable for training deep learning neural network models.

Task 2: Building a library of tagged images, using various right-of-way (ROW) and pavement surface images from different vendors.

Task 3: Development of a model for flagging recently replaced slabs on jointed plain concrete (JPC) pavements and patches on asphalt.

Task 4: Development of a model for categorizing the drainage conditions and other roadside features at various locations.

Task 5: Georgia Tech subcontract.

Task 6: Final report and possible pilot implementation.

WHAT IS OUR GOAL?

The goal of this project is to propose improvements to APCS data collection to facilitate advanced image analysis and a possible pilot implementation.

WHAT IS THE BENEFIT?

The ability to identify replaced slabs and patching will significantly improve the pavement management modeling. Drainage issues that are identified early will lead to longer lasting pavements and safer roadways.

WHAT IS THE PROGRESS TO DATE?

As of December 2021, the research team has made the following progress:

1. Continued investigating various methods of running deep learning algorithms.
2. Found and imported prior work on replaced slabs. Obtained 2018 APCS images. Extracted ROW images for beginning of drainage work
3. Georgia Tech are now actively working on this project

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