December 31, 2015

Problem Title

Calibration and verification of pavement surface images.

Research Problem Statement

The accuracy of existing data collection methodologies is not traceable or uniform. State highway agency (SHA) practitioners need a way to appropriately calibrate as well as to assess and verify the accuracy of image data collection systems.

Background

With the growing use of imaging systems for conducting pavement evaluations, the industry continues to struggle with how to calibrate the imaging systems and verify that they are properly functioning as intended. While AASHTO Provisional Standards have been created for collecting such imagery, there is still no widely accepted method for measuring the accuracy of such imagery.

Research Objectives

1. Determine traceable, objective, practical, repeatable, and transparent methods and approaches to assess the accuracy of the system and the subsystem components.
    a. Develop or identify a methodology to calibrate the image data collection systems and subsystems.
    b. Develop measures and approaches to assess the appropriateness and relevancy of such a calibration methodology.
    c. Develop appropriate measures and methods to determine the accuracy of the image data collection system.
    d. Verify the reliability of these measures and methods under actual conditions.
2. Develop a system level accuracy statement.

Potential Benefits

The successful completion of this research should enable agencies to specify desired levels of accuracy for imaging systems, and a proven evaluation method to confirm the specifications are being met.

Relationships to Existing Body of Knowledge

Imagery is used in a similar capacity for evaluating quality for many other industries (i.e. textiles, food processing, etc.). This study should be able to build upon similar work done in these other industries.

Some attempts have been made to transfer this knowledge to the pavement evaluation application. This process has been confounded by the complexity of the images and the environment in which the images must be captured. While most industrial applications can be made in a controlled environment (e.g. lighting, temperature, speed, camera distance, etc.), pavement evaluation has less control (if any) over such factors. The proposed research will need to address how to accommodate such factors in evaluating the accuracy of pavement imaging systems.

Recent studies have attempted to investigate precision and bias of automated systems. In these investigations, researchers continue to struggle with how to separate the variability of the equipment (the precision and bias of the image capturing system) from the variability of the overall system (the precision and bias of the properties to be measured). Included in this struggle is the variability of not only the previous procedures used for recording such data, but the variability of the properties themselves. To accomplish the research proposed, researchers will need to clearly address this distinction between the various components contributing to the variability and establish how best to quantify the precision and bias of the equipment alone.

Tasks

The research will include the following tasks:

1. Survey and review the current SHA and industry practices regarding standards for calibration and verification.
2. Identify gaps in SHA practices and standards for calibration and verification.
3. Determine methods to assess the accuracy of image data collection systems.
4. Develop, test, determine accuracy, and plan for implementation of methods.

Final Product:

The final product of the research is a set of provisional AASHTO standards addressing SHA's needs regarding imaging collection calibration, verification, and accuracy.

Follow-On and Implementation Activities

Once the accuracy of the imagery system is established, this measurement can be combined with the accuracy of the other system components (such as image analysis) to establish the overall system accuracy for comparison against alternative approaches to gathering the desired pavement evaluation statistics.

Funding

$250,000 - $350,000

Research Period

24 to 30 months

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Notes

1. Calibration – (equipment) calibrating the sensors. Methodology of calibration is equipment detail intensive.
2. Verification – How to verify the ground truth of images?

A. Approach 1: Based on standards (ISO)

B. Approach 2: We know what we took an image of. Make sure the equipment records what we saw.