Semi-Annual Progress Report

Project Number and Title: 1.8 Enhancing Intelligent Compaction with Passive Wireless Sensors
Research Area: Thrust # 1, Develop Improved Road and Bridge Monitoring and Assessment Tools
PI: *Ehsan Ghazanfari, The University of Vermont*
Co-PI(s): *N/A*
Reporting Period: *First semi-annual report*
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Overview:

During the past months, we analyzed the collected data from intelligent compaction (IC) field tests in Route 117 project, a reclaimed asphalt pavement (RAP) project to verify the reliability and sensitivity of IC measurement values (ICMVs) to changes in the density and stiffness of the compacted reclaimed base material. During the first phase of reclaiming, 102 dynamic cone penetration (DCP) tests and 27 nuclear gauge density (NGD) measurements were performed on two different segments (each approximately 170 feet) of River Rd. During the second phase of reclaiming, 78 DCP tests and 20 NGD measurements were performed. During construction of hot-mix asphalt pavements, 118 pavement quality indicators (PQI measurements) were performed. In addition, 20 cores were drilled to measure the density of the hot-mix layer. DCP, NGD, PQI, core and IC data were analyzed to develop correlations between ICMVs and in situ measurements. In addition, we started the literature review to identify in situ passive-based sensing systems, capable of detecting changes in the density and moisture content of geomaterial (i.e. soil/asphalt), including frequency doubling reflectenna (FDR)-based passive wireless sensors, magnetic induction, circuit resonance and dual-band antenna. Compared to other in situ passive sensing methods, FDR devices have advantages of low activation power, operating over longer ranges and at higher frequencies, enabling more compact designs.

The overarching goal of the project is to integrate the passive wireless sensing system with IC technology to facilitate the process of geomaterial compaction and pavement performance monitoring. Identifying the most effective passive wireless sensing system for pavement compaction/monitoring is the first step in achieving the overarching goal of the project. In addition, evaluating the uncertainty in ICMVs with respect to spatial distribution of soil/asphalt stiffness is a key step toward designing/integrating an effective passive wireless sensing system. The performed work in previous months helps us move toward the next steps of the project.

The results to date have been discussed with personnel from the Vermont Agency of Transportation (VTrans). A conference paper is under preparation to be submitted to one of the upcoming ASCE conferences.

(a) (b)

Figure 1: IC compaction in the field, (b) Performing DCP test

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Changes:

None

Planned Activities:

The next steps are to evaluate the sensitivity of passive sensing system to changes in the stiffness/density of geo-materials, and to explore viable options for integration of the passive sensing system with IC for field applications.