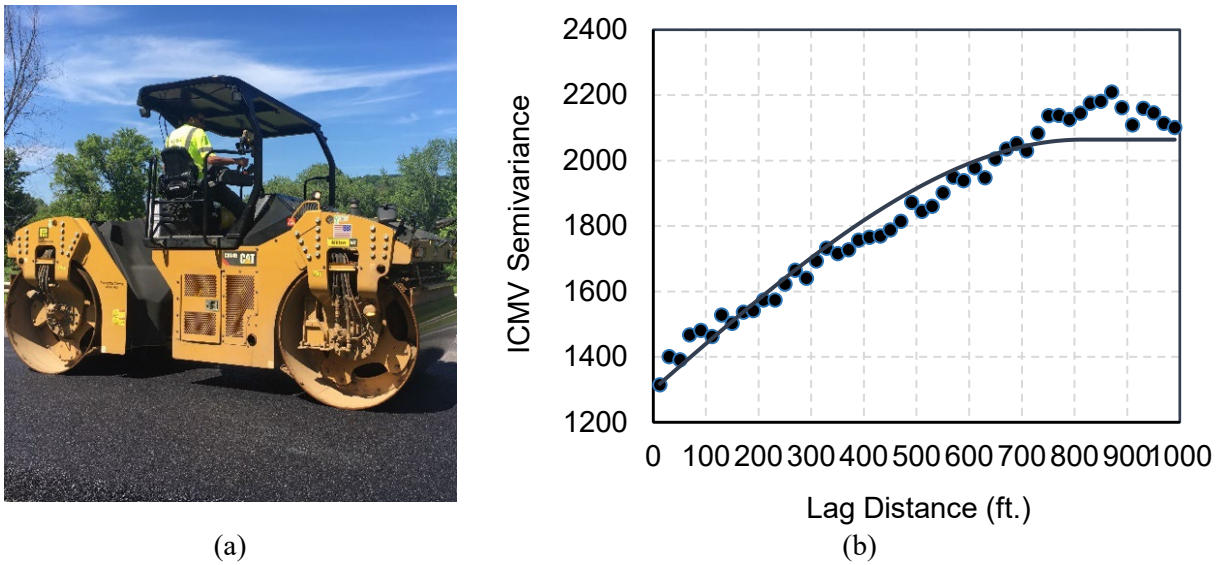
Semi-Annual Progress Report

Project Number and Title: 1.8: Enhancing Intelligent Compaction with Passive Wireless Sensors
Research Area: Thrust # 1, Monitoring and Assessment for Enhanced Life
PI: *Ehsan Ghazanfari, The University of Vermont*
Co-PI(s): *Hamid Ossareh, The University of Vermont*
Reporting Period: *4/1/2019 to 9/30/2019*
Date: *09/30/2019*

Overview: (Please answer each question individually)

During the past months, we continued to perform intelligent compaction (IC) field tests and collect data in Route 117 (Vermont) reclaimed asphalt pavement project to verify the reliability and sensitivity of IC measurement values (ICMVs) to changes in the density and stiffness of the compacted material. In addition, in-situ spot tests including dynamic cone penetration (DCP), nuclear gauge density (NGD), pavement quality indicators (PQI) were performed. Furthermore, a field test was conducted to evaluate potential utilization of ICMVs as a function of vibration amplitude and frequency in the control system, with the goal of optimizing the compaction process. Finally, the spatial variability of the ICMVs were evaluated using semivariograms, a geo-statistical analysis tool used to assess the spatial uniformity of the compacted area (example shown in Figure 1). With regards to implementing passive sensors, we worked with a sensor manufacturing vendor (Phase IV Engineering Inc.) to explore viable options for design and ruggedization of the pressure sensors to survive the extreme pressure and temperature during compaction process. The overarching goal of the project is to improve the IC performance and facilitate the process of geomaterial compaction and pavement performance monitoring. Evaluating the uncertainty in ICMVs with respect to spatial distribution of soil/asphalt stiffness, utilization of ICMVs as a function of vibration amplitude and frequency in the control system to optimize the compaction process, and effective design and ruggedization of passive wireless sensing system for pavement compaction/monitoring are key steps toward IC performance improvements. 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 accepted for publication in the proceedings of ASCE Geocongress 2020, and another abstract is accepted for the upcoming 4th International Conference on Transportation Geotechnics.



(a) (b)

Figure 1: IC compaction in the field, (b) The semivariogram plot for ICMVs in field test

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Participants and Collaborators:

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Changes:

The main encountered problem was survivability of passive sensors under extreme temperature/pressure during compaction process. We continue to explore alternative design and ruggedization options for the passive sensor to resolve the issue.

Planned Activities:

(i) analysis of the collected data from IC field tests aiming at IC performance improvement
(ii) continue exploring viable options for design and ruggedization of passive sensors in IC compaction
(iii) planning field tests for upcoming construction season