Enhancing Intelligent Compaction with Passive Wireless Sensors

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Problem Statement

Intelligent compaction (IC) is a modern compaction technique that provides the roller operators with monitoring of IC measurements as a real-time visual feedback. Utilizing IC roller can potentially improve the consistency of compaction, extend the pavement life service, and reduce the maintenance costs (Mooney et al., 2010). Despite the recent advancements, in many cases the variation of intelligent compaction measurement values (ICMVs) cannot be appropriately explained by the actual stiffness of the compacted material. Therefore, the regression models involve considerable uncertainty and need further improvement.

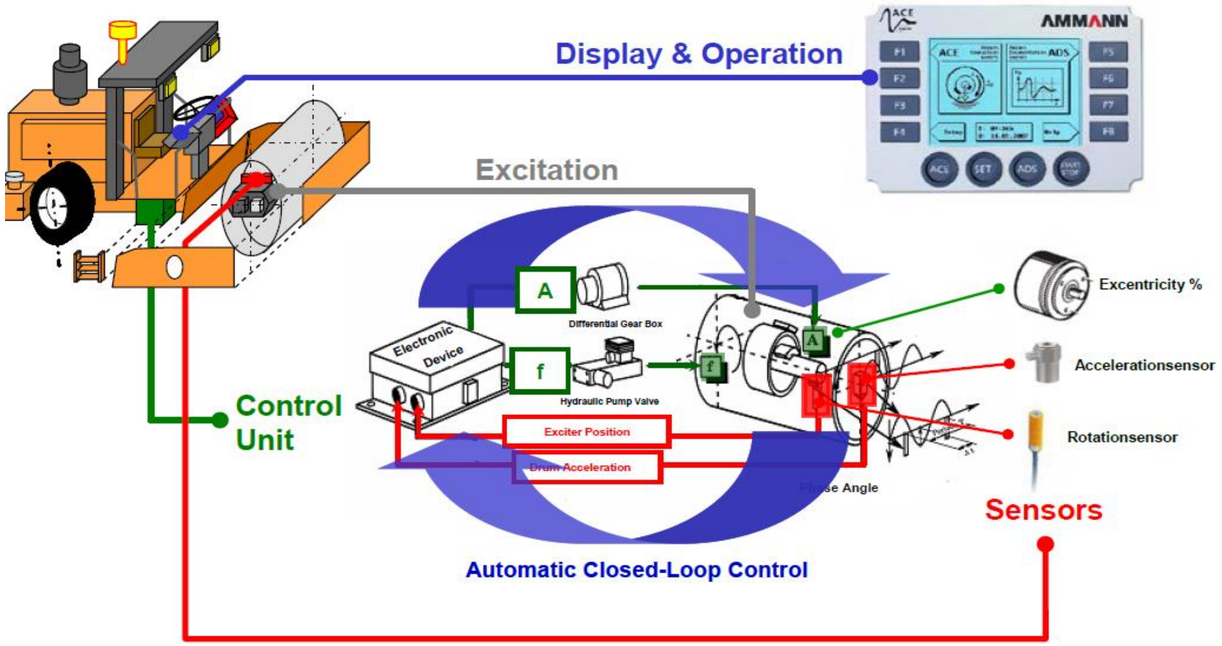

Figure 1. IC roller feedback system (Change et al., 2016)

Background and Introduction

IC performance can be potentially improved by (i) integrating passive wireless sensing system with IC, (ii) utilizing ICMVs as a function of vibration amplitude and frequency in the control system, followed by adjustment of these parameters to optimize the compaction process, and (iii) designing filters to improve consistency of ICMVs in order to minimize compaction variance. In this project, we are exploring the aforementioned options to improve IC performance for geomaterial compaction.

Data Collection and Action Taken

During IC compaction of a reclaimed base project in Route 117 in Vermont, IC and spot-test data were collected and analyzed to evaluate the uncertainty associated with ICMVs with respect to spatial distribution of pavement stiffness. In addition, cost-effective in situ passive-based sensing systems were identified and are planned to be implemented in future field testing.

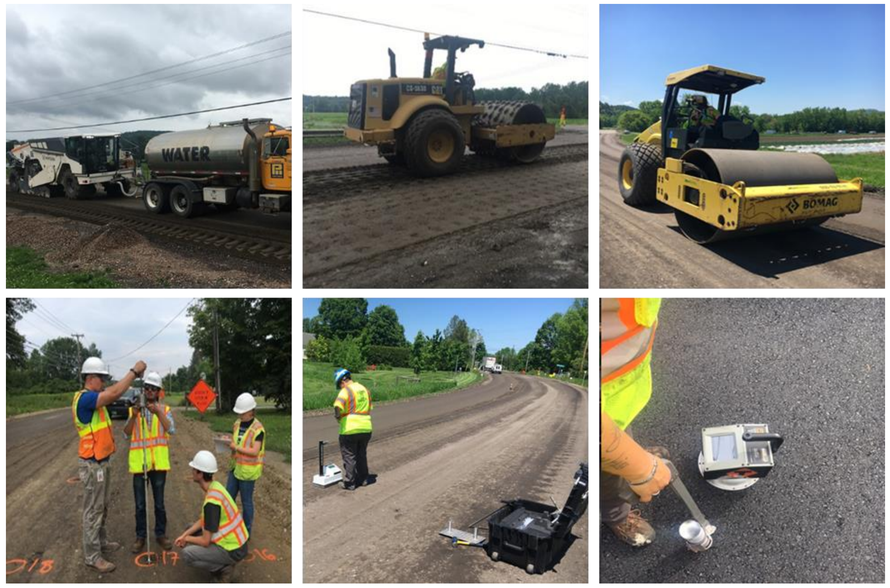

Figure 2. Data collection process in Route 117, VT

Conclusion and Future Plan

The next steps include (i) collecting additional field data at different roller vibration frequencies targeting enhancement of IC performance via utilizing feedback from the control system, and (ii) exploring viable options for design and ruggedization of the pressure sensors to survive the extreme pressure and temperature during compaction process.

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References

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