

UTC Project Information	
Project Title	MPC-601 – Sensitivity and Accuracy Assessment of Vehicle Weigh-in-Motion System Measurement Errors Using In-Pavement Strain-Based Sensors
University	North Dakota State University
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Brief Description of Research Project	<p>Measuring the weights of passing vehicles at highway speed is an important activity of any intelligent transportation system. Wight-in-motion (WIM) technology has various application in highway management, infrastructure investment optimization, law enforcement, and pavement design. The measurement accuracy of a WIM is critically important for some WIM applications such as law enforcement, highway capacity analysis, and pavement design ect. Different from previous work, our study focuses on understanding the relationship between the accuracy of an in-pavement strain-sensor based WIM system and its external contributors such as humidity, temperature, wander behavior and wind speed, which the authors found unclear from literature search. Such research is very important for WIM quality assurance application successes. Since the accuracy of WIM data is highly dependent on many factors, such as</p>

	<p>temperature, vehicle speeds, precipitation, cross wind speeds, and the evenness of the road surface. In general there are about 0.97% anomalies in vehicle class and 6.42% anomalies in vehicle weight. With that error, a WIM system can underestimate about 90% of truck weights and the degree of underestimation can exceed 50% of the corresponding static weights. The objective of this study is to provide scientific evidences of the systematic sensitivity analysis on the influences of external contributors on the measurement accuracy of a WIM system based on in-pavement strain sensors. The main external contributors to be investigated in this study include air temperature, vehicle wander behavior, air humidity, and wind speed on the measurement accuracy of a WIM system.</p>
<p>Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here</p>	<p>The research outcomes have been validated through extensive simulations and field experiments, demonstrating their efficacy in enhancing pavement performance prediction and vehicle weight monitoring. While full-scale implementation across transportation networks requires further collaboration with industry stakeholders and regulatory bodies, pilot projects hybrid WIM systems are installed with MNRoad project. These pilot implementations aim to assess real-world applicability, scalability, and integration with existing infrastructure. The success of these initiatives will pave the way for broader adoption, leading to more resilient and efficient road networks.</p>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>The research introduces a cost-effective hybrid WIM system that increases vehicle weight monitoring accuracy by over 90% at close sensor distances, addressing the vehicle wander effect. The random survival forest method revealed that overweight traffic can reduce pavement life by 16-43% for longitudinal cracking, 3-42% for alligator cracking, and up to 33% for rutting, guiding more effective infrastructure management strategies. The approach led to six journal publications, two conference presentations, and has garnered 43 citations on Google Scholar and 493 reads on ResearchGate, highlighting its growing influence and potential to shape future developments in traffic management and infrastructure planning.</p>
<p>Web Links</p> <ul style="list-style-type: none"> • Reports • Project Website 	<ul style="list-style-type: none"> • MPC Final Report – Sensitivity and Accuracy Assessment of Vehicle Weigh-In-Motion System Measurement Errors Using In-Pavement Strain-Based Sensors