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AN APPROACH TO MINIMIZE WEIGHING ERROR OF WIM SYSTEM BASED ON AMBIENT TEMPERATURE

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ABSTRACT
Weigh-in-Motion (WIM) systems that use the polymeric piezoelectric sensors are strongly affected by temperature variations (**Error! Reference source not found.** and **Error! Reference source not found.**). Thus, measurements of pavement temperatures are required to improve the accuracy of the axle weights as well as gross vehicle weight (GVW). Since piezoelectric material uses the mechanical force generated by the tire of a truck to measure the axle weight, the stiffness of the pavement has a great influence on the final weight estimation (**Error! Reference source not found.**). Although the pavement temperature has a key role in the accuracy of weight estimation, it is not practical to instrument the temperature sensors at every WIM stations because of additional effort and system to collect the temperature data. Alternatively, ambient temperature is always available at nearby weather stations. Therefore, an approach capable of using ambient temperature to estimate pavement temperature is highly valuable when trying to improve the accuracy of WIM data.

There have been several studies to develop models to predict the pavement temperature from ambient temperature (**Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**). Among these studies, Diefenderfer et al (**Error! Reference source not found.**) developed a model conducted within Virginia Smart Road project using two Long Term Pavement Performance (LTPP) Seasonal Monitoring Program sites to estimate the maximum and minimum temperatures for each day by incorporating solar absorption and radiation. The most relevant work on trying to adjust the WIM data is the study by Southgate (**Error! Reference source not found.**). In this approach, a stable correlation between the front axle weight (FAW) and the steering axle spacing of Class 9 (3S2) truck was used to calibrate the WIM data using a logarithmic regression. The work proposed by Chou and Nichols (**Error! Reference source not found.**) utilized time series analysis to remove temperature induced variations in the estimation of weights using the correction factors derived from Class 9 trucks by hour and day.

In this present work, an approach to minimize the error of WIM data based on the correlation of ambient and pavement temperature is presented. The approach uses the model proposed by Diefenderfer et al (**Error! Reference source not found.**) to correlate the maximum and minimum ambient temperature with those pavement temperatures. Two case studies are presented. The first site is in New York metropolitan area in the U.S. and a WIM controller named high-speed WIM (HS-WIM) was installed in late 2015 and calibrated in early 2016. A sample of data raging from March 2016 to August 2016 is used. The data for the second site were collected in a WIM station located in the State of São Paulo in Brazil, and the same HS-WIM system was installed in late 2015, and two calibrations were conducted. A sample of data raging from June 2016 to December 2016 is used. In both cases, the installation of the monitoring system and the data collection is in accordance with the recommendations of ASTM E1318 (2002).