

## **Guo, Lianhe, “Study of Weigh-In-Motion Sensors”**

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The Weigh-in-Motion (WIM) system is a promising technology to weigh moving vehicles. The study was started as early as the 1950's with the research of sensors measuring the mechanical strain induced in load cells and highway bridges. Then, the WIM sensors embedded in pavement were introduced and evaluated widely. But no satisfactory WIM sensor was found.

To evaluate WIM sensors and techniques, the WIM system standard was introduced and available WIM sensors in the market such as load cells, bending plates and piezoelectric sensors were reviewed in this dissertation. Then, a remote WIM system was designed and installed to conduct the sensor evaluation. The designed system could be accessed remotely and was capable of conducting the data acquisition from multiple sensors. With the acquired field data, a pavement deflection weight determination algorithm was developed and its result was compared with the integration algorithm. The analysis showed that pavement deflections could be used for the vehicles' weight measurements and the conclusion was helpful for the nondestructive WIM system design. In addition to the evaluation of WIM sensors, an innovative microwave WIM sensor was developed in this dissertation. It was an active sensor based on the perturbation theory of microwave resonant cavities. The microwave signal generated by a circuit was coupled into the sensor and the returned signal was measured to determine the load applied on the sensor. The microwave WIM sensor was designed, simulated and tested in the lab. The TE<sub>1,1,L</sub> cavity mode of the sensor was found to be a good mode for WIM applications. Furthermore, the sensor showed an excellent linearity, uniformity and measurement accuracy from the results of the lab test.