Analysis of Pavement Conditions through Sensor Vibration Data

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Our team’s challenge was focused on infrastructure and monitoring pavement conditions through vibration data. Pavement conditions and how to measure them have become an important focus for highway agencies. The more damage the roadway has, the more damage to the cars there is and the same is true as to the people inside. Without proper maintenance and a way to monitor the damage, the infrastructure, car, and person inside can suffer the consequences. IRI (International Roughness Index) has been the method for measuring the pavement conditions, however it can be costly and ineffective, so our method involves using a cheaper method that also provides more in depth data through vibration data attached on each tire’s suspension. So, our main objective was to integrate a vehicle-based sensing system and a full car model to better estimate the asphalt roughness and identify common cracking locations with better accuracy.

Approach / Methodology

Our data examined two stretches of freeway in Phoenix Arizona. The first area being a north and south bound freeway which was the I-10 from Chandler Blvd to Baseline road. The second area was east and west bound on the I-10 between 27th and 51st ave. The other student on this project did the north/southbound region and I did the east/west bound area. The approach that was followed was a series of numerical analysis done using ArcGIS and Excel. Both the IRI data from ADOT and the collected vibration data were uploaded into ArcGIS to be able to compare the data and find common points of poor conditions. After a common point was found, the respective IRI data was put into excel as well as the range of Zg (acceleration) data surrounding the point. Next, an average of the surrounding Zg data was taken from the two front tires in order to get a single number to compare to the IRI data. This was done over and over to gather a wide range of corresponding acceleration data points with IRI points. Finally, all these points were put into a table and graph to show the correlation between the vibration data and IRI. These graphs can be seen to the right in addition an ArcGIS map of the section worked on and the sensors used can be seen below.

Outcomes / Results

Our results showed that the vibration data was in fact accurate and could be used in the future as a method of analyzing pavement conditions. As can be seen in the figures on the left, the R^2 value, or the correlation coefficient is .8 for the specific East/West bound section and is .86 for the compiled data between North/South and East/West bound. These are both very high correlation coefficients and are evidence that the data is accurate. The IRI and the Zg (acceleration) data match, as IRI goes up as does the Zg data. This shows that the use of GIS mapping and excel data analysis in conjunction with syntax programming provides a systematic, fast, and accurate approach to retrieve data points among a huge amount of raw data essential for further regression analysis.

References


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