

The Use of GIS and Vibration Data to Identify Pavement Distress Areas along Bike Trails

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The existing infrastructure systems in the United States are in a critical need of maintenance and repair. The Transportation system is one of the main infrastructures that require maintenance. Pavement is a fundamental element in the transportation system. Pavement condition in the United States is deteriorating with time, creating a significant impact on the nation's economy. Pavements deteriorate due to various factors such as, traffic load, soil and weather conditions. There have been many challenges facing transportation agencies to maintain pavement condition due to limited budgets. Thus, there is a need for effective pavement assessment techniques that can be implemented by transportation agencies. This paper presents a cost-effective method to assess pavement condition along bike trails. The method is based on identifying the locations with major distresses, utilizing Geographic Information System (GIS) and vibration data. A project was implemented on the campus of Northern Arizona University to investigate the suitability of using this approach to evaluate pavement condition along bikeways.

The implementation phase of the project involved assigning two teams to identify the locations of major distresses along bike trail pathways. Prior to data collection, each of the two teams identified the bikeways along the campus and set a plan to determine the order in which the data will be collected. The distresses along the pavement were identified using an accelerometer application installed on a smartphone that was attached to a bicycle. The speed of the bicycle was kept constant as possible, to minimize the effect of speed on the vibration data. The application used in the study to measure vibrations is called myVibrometer and it was installed from the Apple store for less than $2. It measures the accelerations by recording the instant vibration values along the x, y, and z directions, heading and course in degrees, speed in meters per second, altitude in meters and latitude and longitude in degrees using GPS system. The vibrations in the z-direction were used to determine the severity of pavement deterioration. Vibrations in the z-direction were graphed in excel for each route. A high vibration magnitude indicates a severe crack. After analyzing the vibration data in Excel, the data was imported to GIS. Two maps were created by the teams, showing areas with cracks along bike trails.

The results obtained from the two teams were similar, it showed that most of the severe cracks were along the North campus. The two teams observed mainly three types of pavement distress which are, linear, block and alligator cracking. The results obtained from the analysis were sent to the Facility Services to prioritize areas that require critical repair. The maps allowed the engineers at the facility services to know the locations of severe distress along the campus before doing physical field visits. In conclusion, the method of using GIS and smartphone technology would have positive impacts on the process of pavement maintenance and inspection. It is a fast and cost- effective technique to reflect pavement condition. The implementation of this approach is also faster and easier than traditional pavement management techniques.

Keywords: GIS, Pavement, Vibration, Distress, Maintenance