USING LIDAR DATA TO ENRICH THE DIAGNOSIS OF SAFETY PROBLEMS AND COLLISION CAUSES

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Abstract

The current practices of diagnosing safety problems are associated with many challenges such as the reliance on manual observations, intra- and inter-observer variability, time consumption, and the great effort required to conduct a large-scale diagnosis of an entire road network. This research advocates using LiDAR data to create an accurate 3D model of crash-prone locations which would help identify potential safety problems in a robust and efficient manner. To diagnosis safety issues, different algorithms are used to extract and evaluate roadway features such as available sight distance, horizontal and vertical curves characteristics, cross-section elements, and lateral placement of roadway signs.

Introduction

It is globally accepted that road collisions are a major cause of death and they exert a huge economic burden on both individuals and governments. Consequently, efficient methods to identify causes of road collisions before making recommendations for remedies and mitigations plans are required. The key to selecting an effective countermeasure, for an underlying road safety problem, relies extensively on the ability to accurately identify the factors that might have contributed to a particular location being classified as a crash-prone location. This brings the issue of 'proper diagnosis' to the forefront of any safety mitigation strategy.

Current practice of diagnosing safety-related issues is centered on field visits by trained professionals. Consequently, several challenges arise. For example, intra- and inter-observer variability are introduced due to the reliance on human observers. Inter-observer variation occurs when two or more observers examine the same material with varying results. Conversely, intra-observer variation occurs when a single observer experiences varying results while observing the same material more than once. Obviously, such variations can have profound effects on the overall results of the diagnosis.

Moreover, current methods of measuring road characteristics are subject to human errors which could undermine the diagnosis process or lead to misjudgment. These conventional methods are both time-consuming and labor-intensive, thereby, limiting the implementation of a large-scale diagnosis effort of the entire roadway network.

This research introduces a new technique that could potentially minimize human errors, eliminate variability due to manual observations, collect huge amounts of data on collision-prone sites, and be less disruptive to traffic. This is achieved through the use of Light Detection and Ranging (LiDAR) datasets in the diagnosis of collision-prone locations. Using LiDAR data, information about roadway features including cross-slopes, characteristics of horizontal curves, and roadway profiles could be obtained without the need for long site visits. Having access to a 3D model of a collision-prone location is considered a paradigm shift in the way data could be transformed into information to assist safety professionals in identifying the causes of collisions and the means by which they could be improved.

Methodology

To demonstrate the value of LiDAR in enriching the safety diagnosis process, several locations in Alberta, Canada were analyzed using LiDAR data. The goal was to identify potential safety problems that might have been a cause for a site being classified as a crash-prone location. Different algorithms were used to extract and assess highway features which include, available sight distances, horizontal curve attributes, road profile characteristics, longitudinal slopes, cross-sectional elements, and roadway sign placement.

Conclusions

Diagnosis of collision-prone locations is a routine task for safety professionals, which is tedious, time-consuming, and prone to human error. This paper demonstrates the value of adopting LiDAR technology to perform such tasks. The paper proposes a method which could represent a new epoch for conducting road safety audits. Compared to traditional practice, diagnosing safety-related issues using LiDAR data increases the efficiency and robustness of the process. It also helps alleviate hurdles associated with the conventional diagnosis of road safety problems.