Understanding lane encroachment using a LIDAR measurement device

Christopher Stokes and Jamie Mackenzie

Centre for Automotive Safety Research, University of Adelaide

Abstract

This study described the development of a device for measuring the lateral passing distance to vehicles. The device was evaluated in both laboratory and field settings. In the lab, the device was shown to consistently and accurately determine the distance to static objects and a moving vehicle. In the field, the device was deployed onto the side of an urban road to detect the number of vehicles which encroach into a bicycle lane. Comparisons to a video recording at the same location showed that the device was able to determine the number of passing vehicles encroachments into the bicycle lane.

Background

A range of traffic safety infrastructure applications and laws are being developed, and frequently implemented, which aim to laterally separate vehicles from hazardous objects and each other. Examples of these applications include audio tactile line marking (ATLM) and safety barriers. Often, identifying the performance and any issues associated with these applications require the measurement of vehicle lane positioning and/or lateral offset. Presently, obtaining such data can be expensive; it requires expert equipment, such as the use of infra-red traffic loggers (TIRTLs), or collection and labour-intensive processing of video data (Mackie 2009).

There are numerous applications where an inexpensive and easy to deploy lateral distance measurement device would be useful for conducting preliminary evaluations before larger data collection exercises, or for the inexpensive evaluation of smaller projects. This study describes the development of such a device, along with the evaluation of the performance of the device in the measurement of vehicle encroachment into a bicycle lane.

Device description

The Centre for Automotive Safety Research (CASR) has designed and built a relatively small and lightweight device that can measure the distance to any objects that pass by (see Figure 1). The device is intended to be installed on the side of a roadway and will record the number of vehicles which pass as well as the distance at which they pass. By noting the relative distance to line markings of note (e.g. bicycle lane or centre line), the number of vehicles which encroach past this line can be determined.

The device is comprised of the following parts:

- A single beam LIDAR distance sensor
- A microcontroller with data logger (records distance data to an SD card)
- A 6000 mAh battery
- An on/off switch

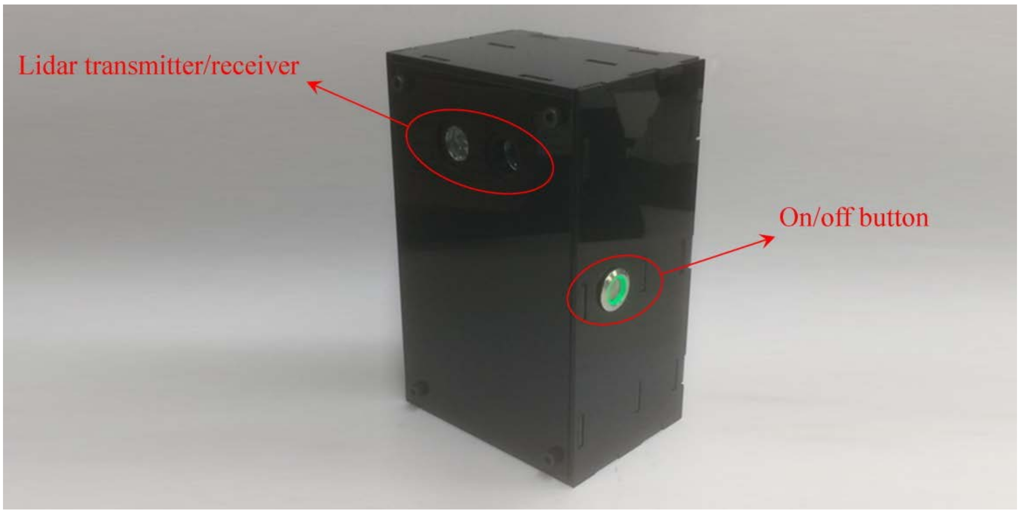


Figure 1. LIDAR lane position and lateral offset measurement device

Method

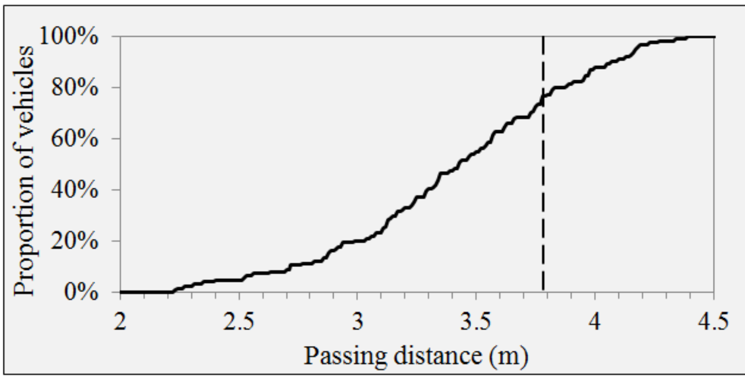
The device was tested in both a laboratory and field settings. In the lab, the accuracy of the device was tested by measuring the distance to a target board to a passing vehicle.

In the field, the device was deployed on the side of an urban road at a location where vehicles often enter a bicycle lane as they are rounding a bend. A video camera was also deployed at the same location to record the number of vehicles which enter the bicycle lane. The recorded LIDAR data and video footage were compared to a) determine the proportion of passing vehicles captured by the device and b) the accuracy in identifying vehicles which encroached into the bicycle lane.

Results and conclusions

The lab results confirmed that the LIDAR device was able to consistently record accurate distances and detect the presence of a passing vehicle.

The field results showed consistency between the data collected using LIDAR and the video. Both methods identified the same number of passing vehicles and a similar distribution of vehicles passing inside, along, or outside the bicycle lane separation line (Figure 2). A benefit of the LIDAR method was the ability to produce a higher resolution, quantitative distribution of passing distances, as observed in the cumulative distribution function in Figure 2.



Position	LIDAR	Video
Inside	85	81
On line*	14	21
Outside	25	22
Sum	124	124

**For the Lidar measurements, a vehicle was estimated to be on the separation line if within 80mm of the measured distance to the 80mm wide separation line.*

Figure 2. Cumulative distribution function of passing distance measurements of vehicles using LIDAR (left, the dashed line represents the distance to the bicycle lane separation line). Numbers of vehicles passing inside, along, and outside the bicycle lane separation line (right).

References

Mackie, H., 2009. The effect of dashed and solid white audio-tactile centre lines on driver behaviour and public acceptance. Transport Engineering Research New Zealand Limited. New Zealand Transport Agency.