Analysis of pedestrian-vehicle crossing interaction

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Abstract

A big focus has been given to soft modes of transportation. In this way, it is necessary to create the best safety conditions for those who are the most vulnerable users of the road network, with the greatest emphasis to pedestrians. The main goal of this work is to identify the factors which contribute to risk-taking behavior by these road users, by analyzing pedestrian's crossing behavior using data collected through video recordings in real crosswalks and the execution of experiments in a virtual environment. First results show that the proximity of the bus stops to the crosswalk, the width of the street occupied by parking spaces and the average width of the sidewalks, the crosswalk width and the pedestrian traffic volume were the variables with significant impacts on the vehicle-pedestrian interaction.

Author Keywords. Pedestrian safety, Pedestrian behavior, Virtual environments, Vehicle-pedestrian interaction, Risk assessment

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1. Introduction

There is currently a constant interest in road safety. Several movements are taking place each year with the emphasis on soft modes of transport, including cyclists and pedestrians, due to the social and environmental advantages they have. Seeking to prevent the occurrence of accidents that could have serious consequences, promoting greater comfort and safety for all users of the road network, is a priority. As far as pedestrians are concerned, there is still a hard work to do. In Portugal, 130 people died while they were walking, which corresponds to 22% of the deaths that happened on the roads in 2018 (ANSR 2018, European Comission 2018). The present work had the main goal of assessing the vehicle-pedestrian interaction at crosswalks to identify and evaluate factors that might influence the pedestrians' safety, aiming to contribute to the process of improvement of their safety conditions.

2. Materials and Methods

This work is based on two fundamental parts. First, video recordings of pedestrians crossing of six different crosswalks were made and data about pedestrians and vehicles' trajectories and speeds was collected. The minimum time-to-collision (TTCmin) was calculated for all the encounters occurred between pedestrians and vehicles (see Hayward (1972)). The influence of the variables such as the slope, the width of the road, the width of the parking lot, the crosswalks and sidewalks' width, the bus stop proximity, the pedestrian and vehicular traffic volumes, the type of road surface, the road functional classification and pedestrians' age and gender was analyzed. The six streets were later modelled to be used as scenarios for experiments to be conducted with human pedestrians in a virtual environment (Figure 1).

From the data acquired in the real environment, different types of vehicle approximation movements to the crosswalk were modeled.

Figure 1: Example of a modelled street

The second part corresponds to the conducting of experiments in a virtual environment. At this time the experiments are being performed. A previous experiment was carried out with 10 participants using two of the six virtual scenarios developed aiming to validate their implementation. Each participant assessed a set of stimuli corresponding to the passage of a virtual vehicle. The time-to-collision (TTC) was registered to the time they started the crossing and compared with the values obtained with the video recordings at those streets.

3. Discussion

Regarding to the video recordings data analysis, only the bus stop proximity, the width of the parking lot and the average width of the sidewalks were found to have significant influence on the TTCmin. The TTCmin verified in the crosswalks with a bus stop placed at less than 50 m away was lower than in those which the bus stop was localized more than 50 m away from the crosswalk. The width of the parking lot and the average width of the sidewalks had the same impact on the TTCmin: the bigger their values, the bigger the TTCmin. Concerning to the previous experiment in virtual environments, a big similarity was found between the TTC obtained in virtual environment and in real environment.

4. Conclusions

Some important results were found in the analysis of the pedestrian-vehicle crossing interactions, although the small data sample used. In the future, it is planned to conduct this kind of analysis based on TTC and other surrogate safety measures, using a data sample with the double size of that used in this work. The virtual scenarios and the experimental approach were validated. Nonetheless, the results allowed to identify some areas of improvement to work on regarding the experimental procedure.

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