A LOGICAL MODEL OF DRIVER DECISIONS ON STRAIGHT ROAD SEGMENTS AND BENDS FOR VEHICULAR SAFETY APPLICATIONS

H.M.A.J. Herath*[1], S. Wijesingha[1] and M.J. Walpola[2]
[1]Department of Electronics, Wayamba University of Sri Lanka, Kuliyapitiya
[2]Department of Computer Science and Engineering, University of Moratuwa
**Corresponding author (email: akila@wyb.ac.lk)*

Introduction

To develop collision warning applications including Sri Lankan ground transport culture, it is necessary to study the movements of vehicles and driver decisions in road way. This study is based on an ongoing research on collision prediction with the concept of exchanging local parameters such as location, speed and acceleration with surrounding vehicles to predict their movements to avoid collisions via V2V communication. In this paper the influence of human factors for road accidents were considered while the vehicle type has been ignored. Every vehicle was taken as a one moving unit for the observations. To develop this model, the vehicular movements were observed in different roads and different places which have different traffic densities. Further it was assumed that every road is in the same physical condition. All types of junctions were kept out of the scope because vehicle behavior is different in junctions from straight roads.

Methodology

Preliminary study: **During this phase, information about road traffic analysis was gathered in other countries and within ground transportation system of Sri Lanka. There are three basic road classes in Sri Lanka namely Class 'A' (class 'AA', class 'AB', class 'AC'), Class 'B' and Class 'E'. Since the paper mainly focuses on single lane roads class 'E' was excluded from the population. Therefore, the population consists of 12,173.19 km class 'A' and 'B' roads in Sri Lanka. Our sample was confined to the selected road segments with consideration of traffic density and accessibility.**

Pre preparation: **For the sample, six roads were included and from each road four observation points in straight road segments were selected to be fit into high, medium, low traffic densities and bends. On behalf of identifying most appropriate places, the sample was subjected to an expert review.**

Observations

All together 24 observation points were visited to collect data and each point was observed for six hours. Different events due to vehicular movements were identified during this phase considering three situations. One is head on vehicle (HV) was observed with comparing to the vehicle in front of the head on vehicle (FHV). Secondly base vehicle (BV) movements were observed by comparing with HV and finally rear-end vehicle (RV) was observed comparing to BV. Change of acceleration, relative speed and relative position of the vehicle were the main parameters recorded and next movement of the immediate rear vehicle was also recorded with the change of distance. All the observations were taken in naked eye vision.

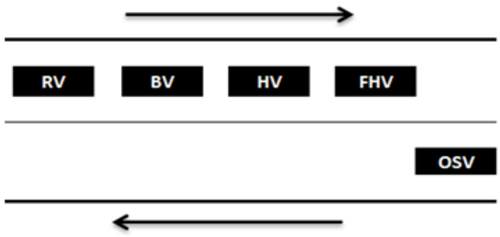

Figure 1. Vehicle position on a single lane road

Analysis

From the observations 3 tables were constructed for three comparable situations were considered which have data of acceleration and, speed combinations and, number of overtakes, slowdowns, stops/turns recorded form all 24 locations. That data was graphed into a line chart applying average number of events (overtakes, slowdowns, stops/turns) per hour for y axis and all possible combinations of speed and accelerations (as indexed in the result table) for x axis for all observation points. With that authors were able to define most possible driver decisions according to all possible relative movements of the immediate head vehicle.

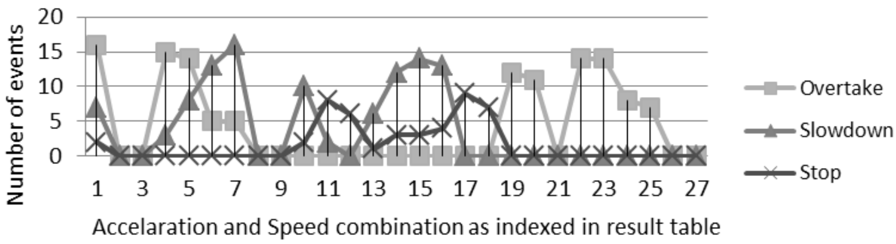

Figure 2. Average number of events per hour for relative speed and acceleration

Results and Discussion

Authors observed that the movements recorded for HV comparing to FHV, BV comparing to HV and RV comparing to BV were same for the same speed and acceleration combination(s). Following are the combinations that lead drivers to take emergency movements in single lane straight road segments.

Table 1. Driver decision of the base vehicle

Index	Combination	BV Driver Decision
1	BV-No Acceleration, HV-No Acceleration, HV in Low Speed	Overtake
4	BV-No Acceleration, HV-Decelerating, HV in Low Speed	Overtake
5	BV-No Acceleration, HV-Decelerating, HV in Same Speed	Overtake
6	BV-No Acceleration, HV-Decelerating, HV in High Speed	Slow down

7	**BV-No Acceleration, HV-Accelerating, HV in Low Speed**	**Slow down**
10	**BV-Decelerating, HV-No Acceleration, HV in Low Speed**	**Slow down**
11	**BV-Decelerating, HV-No Acceleration, HV in Same Speed**	**Stop / Turn**
12	**BV-Decelerating, HV-No Acceleration, HV in High Speed**	**Stop/ Turn**
13	**BV-Decelerating, HV-Decelerating, HV in Low Speed**	**Slow down**
14	**BV-Decelerating, HV-Decelerating, HV in Same Speed**	**Slow down**
15	**BV-Decelerating, HV-Decelerating, HV in High Speed**	**Slow down**
16	**BV-Decelerating, HV-Accelerating, HV in Low Speed**	**Slow down**
17	**BV-Decelerating, HV-Accelerating, HV in Same Speed**	**Stop/ Turn**
18	**BV-Decelerating, HV-Accelerating, HV in High Speed**	**Stop/ Turn**
19	**BV-Accelerating, HV-Accelerating, HV in Low Speed**	**Overtake**
20	**BV-Accelerating, HV-Accelerating, HV in Same Speed**	**Overtake**
22	**BV-Accelerating, HV-Decelerating, HV in Low Speed**	**Overtake**
23	**BV-Accelerating, HV-Decelerating, HV in Same Speed**	**Overtake**
24	**BV-Accelerating, HV-Decelerating, HV in High Speed**	**Overtake**
25	**BV-Accelerating, HV-Accelerating, HV in Low Speed**	**Overtake**

("no driver decision" combinations were removed from the index)

Conclusions

A driver's decisions mainly depend on the movements of its immediate upfront vehicle. By observing relative movement of HV and FHV it is possible to predict the movement of HV before it takes the action and warn the driver of the BV about collision possibilities. Instead of road safety applications which detect and inform the collisions, it is possible to develop applications to predict and warn about the collisions. For that purpose, it is necessary to use a well-functioning vehicular network to pass parameters and each vehicle can process them to predict collision possibilities.

References

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