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Invited Paper

Analysis of Near-miss Incidents between Car and Bicycle at Non-Intersection

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Abstract. In this paper, we discuss near-miss incidents of vehicles with cyclists, especially at non-intersection. To analyze many incidents effectively, we firstly categorized incidents to seven typical scenarios. These scenarios were created based on the near-miss incidents collected in "Hiyari-Hatto Database". In particular, we focus to "place of occurrence", "running position of bicycle", and "visibility". As a result, at intersection, the most common situation was as follows; when the driver approaches to intersection without traffic signals and with poor visibility, the cyclists come into the intersection from right or left. On the other hand, at non-intersection, a cyclist changes their direction because of obstacle such as parked vehicle or pedestrians. In this research, we tried to clear the typical action of cyclists at non-intersection.

1. Introduction

In recent years, many people in Japan use bicycles. The typical reasons are as follows; for health, for economic, and so on. In Japan, the number of fetal accidents is decreasing year by year [1]. Pedestrian, cyclists and vehicle driver consist most of the accidents, it reaches almost 70 %.

Many Advanced Driver Assistance Systems (ADAS) are developed and implemented in recent years. Semi-autonomous and autonomous driving cars come into wide use. Therefore, protection technology for vehicles and pedestrian is one of the most attracted areas. On the other hand, protection technologies for cyclists are insufficient.

In this paper, we focus on cyclists who are treated as both victims and assailants. In particular, to reduce the number of traffic accidents, it is important to protect vulnerable road users. Although the cyclists are similar to pedestrians, there exist some typical features for motion of cyclists. To reveal these features we created some scenarios for cyclists in near-miss incident scenes. By using scenario for near miss incident scenes, it reveals some features such as relative position, speed at incidents, and margin to accidents [1],[2].

2. Creating Scenarios

To analyze near-miss incidents for cyclists, we firstly created some scenarios. The advantage for using scenarios is as follows;

Table 1 shows the scenarios for cyclists. We fist considered the occurrence point, i.e., intersection or non-intersection. Second, the existence of traffic signals is considered. Third, cruising side of cyclists must be included. Finally, at intersections, visibility is one of the most important factors.

Table 1 Typical scenarios for cyclist

Scenario No.	Sub No	Description
S1	S11	Cyclists go on left side of the road and into intersection, w/ traffic signals and poor visibility
	S12	Cyclists go on left side of the road and into intersection, w/o traffic signals and with poor visibility
S2	S21	Cyclists go on right side of the road and into intersection, w/ traffic signals and poor visibility
	S22	Cyclists go on right side of the road and into intersection, w/o traffic signals and with poor visibility
S3	S31	Cyclists enter into the road from road side, sidewalk and crossing
	S32	Cyclists enter into the road between parked cars or crowded people
	S33	Cyclists enter into the road from between cars or buildings
Others		others

3. Data for Analysis

Based on the scenario in Table 1, we extracted near-miss incident data that are collected in "Hiyari-Hatto Database", which has being managed by Smart Mobility Research Center at TUAT (Tokyo University of Agriculture and Technology).

The number of extracted data was 185. All the 185 data is high-level incidents. Then, from the 185 data, road environment, actions of cyclist and driver, and so on were read out to evaluate near-miss incidents quantitatively.

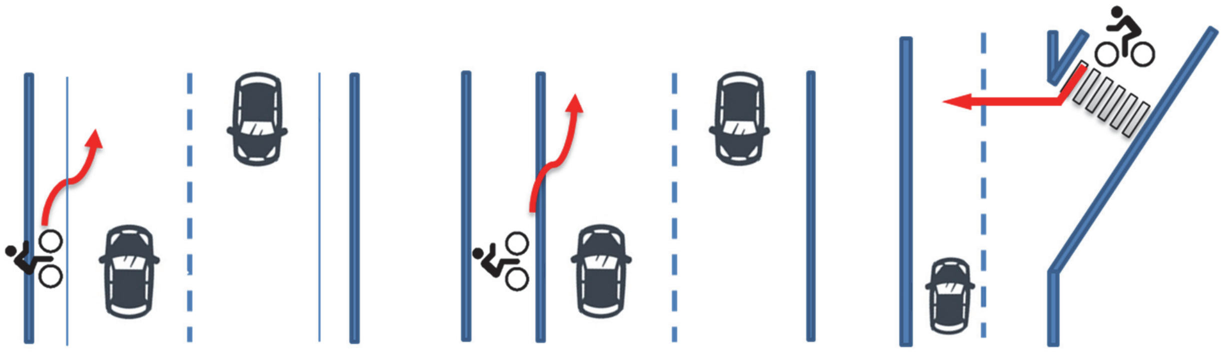
In the rest of the paper, we focus on the scenario S3, which describes the incident at the place other than intersection.

4. Typical Near-miss Incident at Non-Intersection

4.1 Typical Situations of Scenario S3

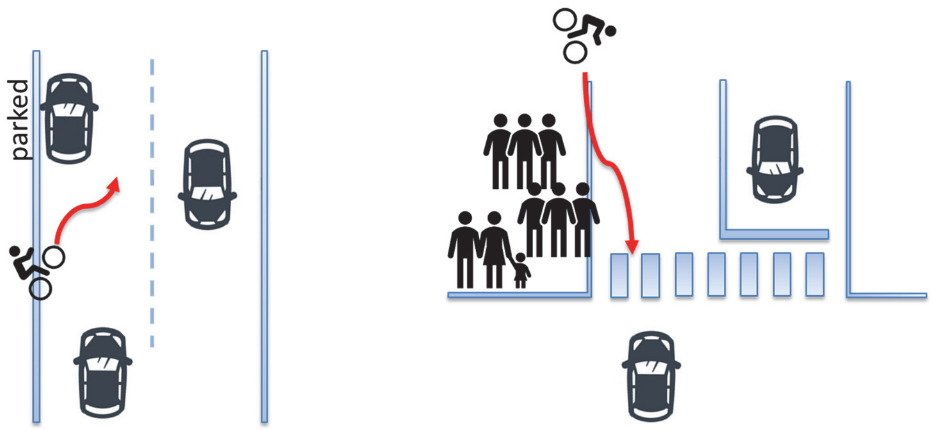
As in Table 1, the scenario S3 is divided into 3 sub-scenarios, S31, S32, and S33. The typical situations of these scenarios are shown in Figs. 1 ~ 3. Fig. 1 illustrates the scenario S31 that a cyclist suddenly enters roadway from sidewalk or pedestrian crossing. In the scenario S32 shown in Fig. 2, a cyclist avoids a parked vehicle or pedestrian. However, a cyclist did not pay attention to arriving vehicles. The scenario S33 is a situation where a cyclist appears from behind the object such as parked or stopped vehicle, buildings, and etc., as shown in Fig. 3. Almost all this situation occurs in crowded urban area.

Among these 3 scenarios, the scenario S31 is the most difficult situation since a cyclist suddenly changes their direction. It is very difficult to detect abrupt their motion from the vehicle. The scenario S33 is also difficult situation. However, if there are many parked vehicle at roadside in continuously, it is possible to assume that something or someone would suddenly appear between the parked vehicles or buildings. On the other hand, the scenario S32 is one of the easiest situations since the vehicle can detect a cyclist and obstacle in front of the cyclist.



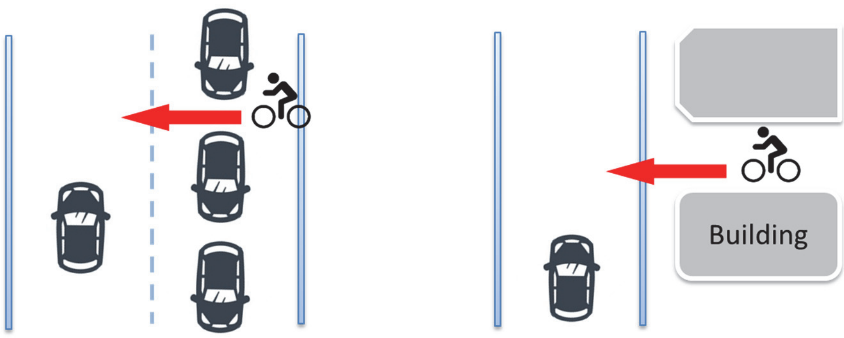
(a) From a shoulder of road (b) From a sidewalk (c) From a crossing

Fig. 1. Typical situation of scenario S31. A cyclist enters into roadway from sidewalk or pedestrian crossing.



(a) Avoid parked or stopped vehicles (b) Avoid pedestrians

Fig. 2. Typical situation of scenario S32. A cyclist enters roadway among parked vehicle or pedestrians (avoid some obstacle).



(a) Between parked or stopped vehicles (b) Between buildings

Fig. 3. Typical situation of scenario S33. A cyclist enters roadway between stopped vehicle or buildings (behind some obstacle).

4.2 Direction of Entry

Fig. 4 shows the rate of direction of entry by scenarios. In scenarios S31 and S32, the direction from the left occupy the major part of incidents. From Fig. 1 and Fig. 2, it is clear that the reason why the entry form the left is major part of all

On the other hand, the scenario S33 includes incidents that the bicycle entered form the right. Most of these incidents, a bicycle appeared between the parked or stopped vehicles on right side roadway.

The main reason of this fact is as follows. The scenarios S31 and S32 treat the situation where the bicycle and own vehicle cruise to the same or opposite direction. As a result, most incidents occur on the left side of the vehicle. On the contrary, in scenario S33, since there are many parked or stopped vehicles on the opposite roadway, most of the bicycles appeared from the right side. If there were parked vehicles on the same side of the roadway, the number of incidents where the bicycle appears from left might increase. This fact matches to the country where the traffic on the left like Japan.

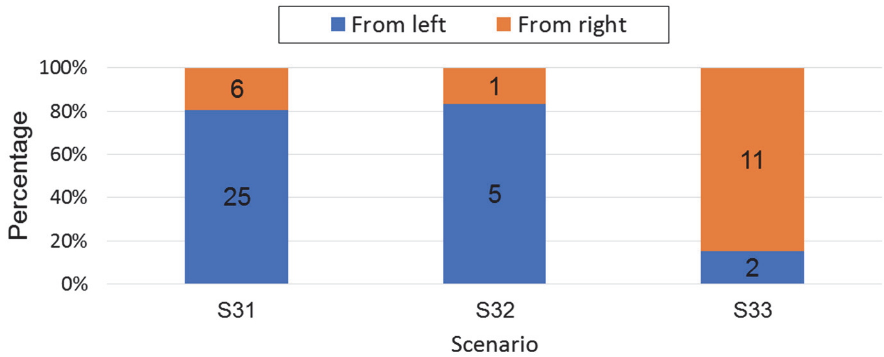


Fig. 4. Direction of entry of bicycles by scenarios.

4.3 Distribution of Velocity

The risk of these incidents depends on not only the situation but also the speed of vehicles or bicycles. The speed of vehicles and bicycle is one of the most important factors. Fig. 5 shows average velocity of own-vehicle at the instance of incident and Fig. 6 average velocity of bicycle. Most of vehicles go less than 40 km/h. It is natural cruising speed around an urban area. However, in the scenario S33, the most frequent velocity was lower than 20 km/h. Since the scenario S33 occurs in crowded area, the average velocity of own vehicle was lower than other scenarios.

Fig. 6 shows the average velocity of bicycle. The most frequent velocity was less than 5 km/h. The velocity is relatively slow.

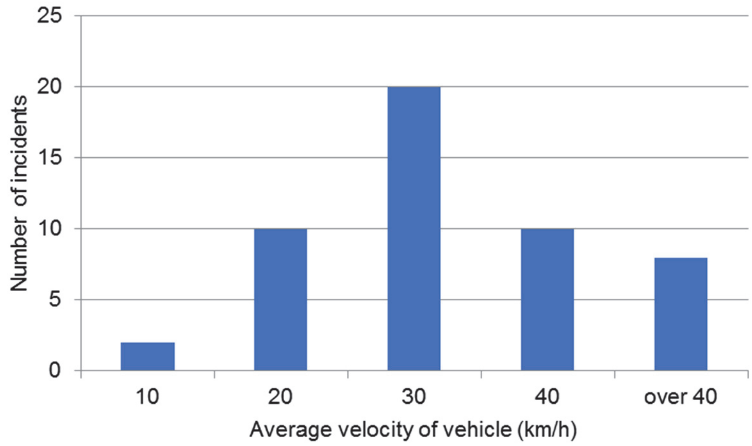


Fig. 5. Average velocity of own-vehicle at the instance of incident.

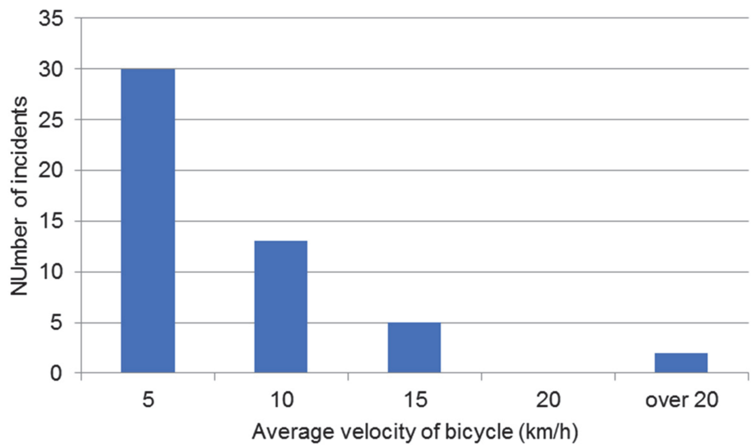


Fig. 6. Average velocity of bicycle at the instance of incident

5. Conclusion

In this paper, we focused on near-miss incidents between car and bicycle. To analyze these incidents, we first categorized the incidents into some scenarios in try and error. The main factors in creating scenarios were occurrence point, cruising side of bicycle, and visibility.

We summarized some qualitative features of the incidents at non-intersection by using scenario. Based on the scenarios, we focused on the incidents occurred at non-intersection. Some features of incidents, such as cruising side or velocity were shown. However, further analysis from diverse perspective is required.

The more detail quantitative analysis is our remaining work.

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